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PHYSICS ABSTRACTS

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Physics Abstracts

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PHYSICS ABSTRACTS

Volume 60 SEPTEMBER 1957 Number 717

MATHEMATICS 51

517.6 : 530.162

7544. NEW TABLES OF FERMI–DIRAC FUNCTIONS. G.A.Chisnall.
Jodrell Bank Ann., Vol. 1, No. 4, 126-40 (Dec., 1956).

Presents tables of the functions

$$F_p(\eta) = \int_0^\infty \frac{u^p\, du}{e^{u-\eta}+1}, \qquad p > -1,$$

for successive half odd-integer values of p.

519.281.2

7545. APPLICATION OF THE PRINCIPLE OF LEAST SQUARES TO FAMILIES OF STRAIGHT LINES. S.Ergun.
Industr. engng Chem., Vol. 48, No. 11, 2063-8 (Nov., 1956).

Errors in the observed values of the variables are considered, especially the case in which the error in the independent variable is negligible compared with that in the dependent variable. Two cases, that of parallel lines, and lines with a common intercept are considered. Applications are made to problems in reaction kinetics and fluid flow through granular solids. L.S.Goddard

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.11

7546. VISUAL HORIZONS IN WORLD-MODELS. W.Rindler.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 6, 662-77 (1956).

This paper seeks to effect a unification and generalization of various particular results on visual horizons scattered in the literature. A horizon is here defined as a frontier between things observable and things unobservable. Two quite different types of horizon exist which are here termed event-horizons and particle-horizons. These are discussed in detail and illustrated by examples and diagrams. The examples include well-known model-universes which exhibit one or the other type of horizon, both types at once, or no horizon. Proper distance and cosmic time are adopted as the main variables, and the analysis is based on the Robertson–Walker form of the line element and therefore applies to all cosmological theories using a homogeneous and isotropic substratum. A.

523.11 : 530.12

7547. DIRAC'S COSMOLOGY AND THE GENERAL THEORY OF RELATIVITY. C.Gilbert.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 6, 684-90 (1956).

An explanation is given, according to the principles of the general theory of relativity, of some results previously obtained by Dirac. It is assumed that there is a different unit of distance for electromagnetic phenomena from the unit of distance used for describing gravitational phenomena. The ratio of these units varies with the time. The former unit gives the usual "cosmic" distance and a Newtonian law of gravitation which is independent of the time, the latter unit leads to a Newtonian law of gravitation for which the gravitational power of matter varies inversely as the epoch. Formulae are derived which enable the age of the universe ($\bar{t}$), Hubble's constant (H) and the mean density of matter in the universe (ω), to be calculated from the values of the constants of atomic theory and the present observed value of the gravitational "constant". It is found that $\bar{t} = 4.1 \times 10^9$ years, $H = 160$ km sec^{-1} megaparsec^{-1}, and $\omega = 4.8 \times 10^{-29}$ gm/cm^3. A.

523.11

7548. A NEW EXPLANATION OF THE RECESSION OF THE NEBULAE. E.R.R.Holmberg.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 6, 691-8 (1956).

The basis of the explanation is the proposal that the space appropriate to cosmology has three, not four, dimensions. The coordinates x, y, z, ct of the so-called light cone are taken to be homogeneous coordinates of a projective space which is then specified to have a uniform elliptic metric. This involves replacing the time coordinate by $W = \sqrt{R^2 - c^2t^2}$ in a manner analogous to the replacement of classical kinetic energy by the relativistic quantity $mc^2/\sqrt{1 - v^2/c^2}$. The radius of the universe, R, is thus introduced explicitly. The components of the 4-velocity vector are shown to be interpretable as the plane coordinates of this space. Clifford's work on the parallels of elliptic space is recalled and used to show that the physical identifications above of a point and plane manifold in elliptic space would lead one to expect the illusion of a recession velocity proportional to distance. A.

523.11 : 539.17

NUCLEAR REACTIONS IN THE LATER STAGE OF THE STELLAR EVOLUTION. See Abstr. 7355

523.112

7549. THE GRAVITATIONAL FIELD OF A STAR IN THE EXPANDING UNIVERSE. C.Gilbert.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 6, 678-83 (1956).

A problem previously considered by Einstein and Straus is solved by the use of new boundary conditions proposed by O'Brien and Synge. The solution joins the Schwarzschild exterior solution of Einstein's field equations to the field generated by a uniform distribution of matter in the expanding universe. It is discussed in relation to previous work on the problem. A.

523.112 : 539.17

FORMATION OF LIGHT NUCLEI IN THE EXPANDING UNIVERSE. See Abstr. 7357

523.164

7550. RADIOASTRONOMY [Radioastronomie]. R.Coutrez.
Uccle: Edition du Patrimoine de l'Observatoire Royal de Belgique (1956) 383 pp. In French.

A comprehensive summary of the whole field of radioastronomy and its relationship to optical astronomy, covering the following topics: the domain of radioastronomy (propagation of electromagnetic radiation, atmospheric absorption); thermal radiation (definitions of flux density, etc., derivation and application of Rayleigh–Jeans, Planck, Stefan's laws, Nyquist's theorem, aerial temperature and radiation temperature); Hertzian waves in radioastronomy (polarization, parasitic dipole systems, etc.); the theory of transmission lines and the application of interferometric techniques; characteristics and calibration of receivers; the optical radiation of the sun (summary of observational data); radiowaves of solar origin (observation and interpretation); physics of the Galaxy and extragalactic nebulae (summary from optical viewpoint); Galactic and extragalactic radio emissions (continuous and monochromatic; discrete sources; scintillation); radiowaves and radar echoes from planets and meteors (observational methods and results). M.W.Ovenden

523.164.4

7551. SYNCHROTRON RADIATION FROM THE CRAB NEBULA. G.Thiessen.
Naturwissenschaften, Vol. 44, No. 2, 26-9 (1957). In German.

A summary of the theory of the origin of cosmic radiowaves by

synchrotron radiation of relativistic charged particles in weak interstellar magnetic fields, and a survey of the observations of the Crab nebula in relation to this theory. M.W.Ovenden

523.164.42 : 551.510.535

7552. RADIO STAR SCINTILLATIONS AT THE TIME OF THE SOLAR ECLIPSE OF 1954 JUNE 30. M.Dagg.
Jodrell Bank Ann., Vol. 1, No. 4, 99-103 (Dec., 1956).

At the time of the total eclipse of the sun on June 30, 1954, scintillations were observed in the intensity of the radio source in Cassiopeia. A discussion of the frequency of occurrence of radio-star scintillations at that time of the day, shows that the two events were probably associated; the chance that they were merely coincidental is about 1 in 5. The significance of this observation on the theories of origin of the scintillations is discussed. A.

523.164.85 : 621.396.11

7553. HEIGHT-GAIN IN THE FORWARD-SCATTERING OF RADIO WAVES BY METEOR TRAILS. C.O.Hines and M.O'Grady.
Canad. J. Phys., Vol. 35, No. 1, 125-7 (Jan., 1957).

The paper concerns the transmission of radio signals in the v.h.f. band over long paths by scattering from meteor trails. Using a relatively refined aerial sensitivity pattern formula, calculations are made of the variation (on arbitrary scales) with aerial height and meteor height of (a) the detection rate of meteors and (b) the mean signal strength obtained by meteoric scattering. Cases when the two aerials are at different heights are also considered.

M.W.Ovenden

523.164.85

7554. RADIO-ECHO OBSERVATIONS OF THE DAY- AND NIGHT-TIME METEOR STREAMS BETWEEN 1954 JANUARY AND 1955 AUGUST. T.W.Davidson.
Jodrell Bank Ann., Vol. 1, No. 4, 116-25 (Dec., 1956).

Describes observations which were made as part of the continuous meteor survey programme. Ephemerides have been computed for the Arietid, ζ Perseid, β Taurid, Perseid and Geminid radiants observed during this period, and have been combined with previous results to give mean ephemerides for these radiants. In 1954 the Geminid hourly rate was 50% greater than the mean maximum rate for this shower, indicating a condensation in the stream. A.

523.165

7555. ACCELERATION OF COSMIC-RAY PARTICLES AMONG EXTRAGALACTIC NEBULAE. G.R.Burbidge.
Phys. Rev., Vol. 107, No. 1, 269-71 (July 1, 1957).

It is proposed that cosmic-ray particles can be accelerated by the Fermi mechanism acting among galaxies in clusters in the same way that Fermi originally proposed for interstellar clouds in our own galaxy. When applied to the local group of galaxies this mechanism does not lead to an appreciable increase in energy over the limit attainable in our own galaxy. However, the conditions in a highly concentrated cluster such as the Coma cluster lead to maximum energies in the range 10^{18}-10^{20} eV. Some implications of these results are discussed. A.

523.53

7556. VARIATIONS IN THE INTRINSIC STRENGTH OF THE 1956 QUADRANTID METEOR SHOWER. C.O.Hines and E.L.Vogan.
Canad. J. Phys., Vol. 35, No. 6, 703-11 (June, 1957).

The occurrence rate of meteoric signals, detected on a v.h.f. forward-scatter path, is analysed for the time of the 1956 Quadrantid shower. The detection rate of the shower meteors is converted to an incidence rate, by use of the appropriate forward-scatter theory. The variation in the intrinsic strength of the shower is thereby determined, on an hour-to-hour basis, and it is compared with variations which have been obtained in other years by other methods. The comparison reveals a distinct secular shifting of the orbit of the Quadrantid meteor stream. It also illustrates the marked advantage of the new technique in assessing variations in the strengths of short-lived showers. A.

523.67 : 535.343

THE SPECTRA OF COMETS. See Abstr. 6993

523.7 : 551.510.535

RELATIONS BETWEEN THE SUN AND THE IONOSPHERE. See Abstr. 7515

523.7

7557. FOCUSSING OF SOLAR-ION STREAMS AND FORMATION OF CORONAL STREAMERS. J.N.Tandon.
Curr. Sci., Vol. 26, No. 1, 12 (Jan., 1957).

The self-focusing of solar ion streams in the presence of a magnetic field is discussed. The critical current for self-focusing depends appreciably upon the magnetic field, and as the magnetic field may be greater at sunspot maxima than at sunspot minima by a large factor, the coronal streamers at sunspot minima may be self-focusing. M.W.Ovende

523.7

7558. THE SOLAR FLARE OF 23 FEBRUARY 1956.
Indian J. Meteorol. Geophys., Vol. 8, No. 1, 7-14 (Jan., 1957).

523.77

7559. THE WAVELENGTH DISPLACEMENTS OF SOME INFRARED LINES BETWEEN LIMB AND CENTER OF THE SUN. L.Herzberg.
Canad. J. Phys., Vol. 35, No. 6, 766-76 (June, 1957).

The wavelength displacements between the solar limb and the centre of the disk, $(\lambda_L - \lambda_C)$, have been measured for six infrared solar lines, belonging to two multiplets of Si I. The displacements of the lines of one of the multiplets are the same, within the accuracy of the measurements; the displacements of the lines of the other multiplet, although varying somewhat amongst themselves, are systematically larger. This grouping of the results according to multiplet structure suggests that the wavelength displacement of solar lines across the disk is term-dependent. It is noted that the variation of the values $(\lambda_L - \lambda_C)$ is, in its essential features, simil to the term-dependent variation of the differences $(\lambda_\odot - \lambda_{lab})$ between the published solar and laboratory wavelengths of silicon. Solar and laboratory data, taken together, appear to provide observational evidence that the observed wavelength variations across the solar disk are, at least in part, due to collision or field effects.

523.841.1 : 530

THE GENERAL RELATIVITY FIELD OF A RADIATING STA See Abstr. 6832

523.8

7560. RELATIVE [O II] INTENSITIES IN GASEOUS NEBULAE. M.J.Seaton and D.E.Osterbrock.
Astrophys. J., Vol. 125, No. 1, 66-83 (Jan., 1957).

523.8

7561. DYNAMIC FRICTION IN A STELLAR SYSTEM. R.Balescu.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 3, 179-87 (1957). In French.

An alternative, and simpler, derivation of the coefficient of dynamic friction in a stellar system of weakly coupled gravitation masses, e.g. a globular cluster, to that proposed by Chandrasekha (1943) makes use of a "master equation" based on the Hamiltonian equation of Brout and Prigogine (1957). The modified theory allow a relatively simple computation to be made which in general may be applied to the derivation of other moments of the distribution function ρ without recourse to the two-body problem that makes Chandrasekhar's classical method of analysis so complex.

D.R.Barb

523.8

7562. ON THE RADIAL PULSATION OF MAGNETIC STARS. S.P.Talwar and J.N.Tandon.
Indian J. Phys., Vol. 30, No. 11, 561-4 (Nov., 1956).

The general equation governing the radial pulsations of magnetic stars has been derived and the integral formula for the frequency of pulsations deduced. The magnetic field is assumed t be continuous across the surface of the star.

523.877 : 539

HELIUM CAPTURING REACTION IN STARS. See Abstr. 73

PHYSICS 53

53.084 : 621.317.1

7563. INSTRUMENT TRANSDUCERS. J.Thomson.
J. sci. Instrum., Vol. 34, No. 6, 217-21 (June, 1957).

After dividing the problems of instrumentation into two categories, (i) the determination of what is to be measured, and (ii) the investigation of how to make the measurement, the importance of energy transformations to problems in the second category is established. The attempt is made to define the forms of energy in a manner suitable for instrument research and a chart is presented showing important physical and chemical phenomena as transformations between these forms of energy. Particular attention is paid to those transducers which provide an electric signal. In conclusion, recent developments of transducers are considered from the point of view of instrumentation and the significance of solid state science is underlined. A.

FUNDAMENTALS 530.1

530.112 : 529.786

7564. THE INFLUENCE OF THE "LORENTZ CONTRACTION" OF THE EARTH ON THE RATE OF QUARTZ CLOCKS. II. L.Courvoisier.
Experientia, Vol. 13, No. 6, 234-5 (June 15, 1957). In German.

For previous part see Abstr. 3055/1954. Further evidence is derived from observations of relative corrections at northern and southern stations for 1951-54. R.A.Newing

530.12 : 531.18

7565. NOTE ON RELATIVISTIC MOTION IN A SCALAR FIELD. N.Rosen.
Bull. Res. Coun. Israel, Vol. 6A, No. 1, 55-60 (Oct., 1956).

The equations of motion in the special relativity theory of a particle acted on by a scalar (meson) field are set up in a form which avoids the difficulty of a variable rest-mass. A.

530.12 : 531.51

7566. THE GRAVITATIONAL FIELDS OF ELECTRIC AND MAGNETIC DIPOLES. G.E.Tauber.
Canad. J. Phys., Vol. 35, No. 4, 477-82 (April, 1957).

Einstein's field equations are solved for cylindrical symmetry in the presence of electric and magnetic singularities (dipoles). A.

530.12

7567. JUBILEE OF RELATIVITY THEORY. [Fünfzig Jahre Relativitätstheorie].
Basle: Birkhauser Verlag (1956) 286 pp. [Helvetica Physica Acta Supplementum IV].

For abstracts see Abstr. 6802, 6811-17, 6820, 6836-51, 6854-7, 6867, 6870 and 6909-10.

530.12

7568. THE "CLOCK PARADOX" OF RELATIVITY. H.Dingle.
Nature (London), Vol. 179, 1242-3 (June 15, 1957).

A distinction is made between the "postulate of relativity" and the "postulate of constant light-velocity", the former being taken to imply that "if two bodies separate and reunite, there is no observable phenomenon that will show in an absolute sense that one rather than the other has moved". The claim that the second postulate involves no asymmetry is reiterated. R.A.Newing

530.12

7569. RECIPROCAL STATIC SOLUTIONS OF FIELD EQUATIONS INVOLVING AN ASYMMETRICAL FUNDAMENTAL TENSOR. H.A.Buchdahl.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1083-93 (May, 1957).

It is shown that from any given static solution of the field equations of Einstein's unitary field theory another static solution may be inferred by inspection. Some special cases are considered. A.

530.12

7570. RELATIVITY. V.Bargmann.
Rev. mod. Phys., Vol. 29, No. 2, 161-74 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). In this general survey, the basic principles of the special theory are discussed with special reference to the development of quantum theory. More detailed consideration is given to the logical and mathematical structure of the general theory. The Kaluza–Klein five-dimensional theory and the Einstein–Schrödinger non-symmetric theory are discussed as examples of unified field theories. Brief consideration is also given to attempts at the quantization of covariant theories. R.A.Newing

530.145

7571. OPERATOR METHODS IN CLASSICAL FIELD THEORY. D.Park.
Indian J. theor. Phys., Vol. 3, No. 4, 143-50 (Dec., 1955).

It is shown how the solution of certain classical problems in the theory of fields — Poisson's integral and its Fourier transform, Lagrange's expansion, the Lienard–Wiechart potentials, Cauchy's problem etc. — can be treated in a simple and unified way by the use of operator methods, in which algebraic and analytic processes are suitably combined. The methods are then used to discuss an equation satisfied by retarded potentials only which is of the first order in the time derivative. A.

530.145

7572. VIOLATION OF SYMMETRY UNDER REFLECTION IN NATURAL LAWS? G.Lüders.
Naturwissenschaften, Vol. 44, No. 9, 273-7 (1957). In German.

An elementary discussion of parity and of the experiment of Wu et al (Abstr. 5593/1957) establishing parity violation is given in a form suitable for non-specialists. G.E.Brown

530.145

7573. QUANTUM RECURRENCE THEOREM.
P.Bocchieri and A.Loinger.
Phys. Rev., Vol. 107, No. 2, 337-8 (July 15, 1957).

A recurrence theorem is proved, which is the quantum analogue of the recurrence theorem of Poincaré. Some statistical consequences of the theorem are stressed. A.

530.145

7574. CHARGE CONJUGATION AND RELATED TRANSFORMATIONS IN THE NUCLEON FIELD. G.Györgyi.
Nuclear Physics, Vol. 2, No. 3, 267-76 (Nov., 1956). In German.

The charge conjugation and related transformations are discussed in the one-particle theory and the quantized field theory of the nucleons as well as the question of the isobaric spin of antinucleons. The components of the isobaric spin of antinucleons can be assigned without contradiction only within the framework of the quantized field theory. A.

530.145

7575. ON THE PHYSICAL SIGNIFICANCE OF THE REDUNDANT SOLUTIONS OF THE LOW EQUATION. R.Haag.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 203-15 (Jan., 1957).

Some arguments are given which indicate that only one solution of the Low equation is acceptable from the physical point of view. The arguments stem from a comparison with the general scattering theory of non-relativistic quantum mechanics. A short study of the situation in a relativistic field theory is included. A.

530.145

7576. ON A NON-LOCAL RELATIVISTIC QUANTUM THEORY OF FIELDS. I. G.Wataghin.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 689-701 (March, 1957).

A new formalism of a relativistic non-local theory of fields is suggested and discussed. In a first approximation special form-factors are introduced and with them a Hamiltonian formalism is developed satisfying the claim of macroscopic causality. The problem of the convergency of the perturbation method in the S-matrix formalism is examined in view of new assumptions concerning the finite life time of the virtual states. A.

530.145

7577. QUANTUM STATISTICS OF FIELDS AND MULTIPLE PRODUCTION OF MESONS.
H.Ezawa, Y.Tomozawa and H.Umezawa.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 810-41 (April, 1957).

Thermodynamical relations in quantum field theory are discussed. This gives a possibility to decide whether or not the interactions are renormalizable, i.e., of the first or the second kind. The renormalization procedure is elucidated by formulating the perturbational calculation. The possibility for proceeding to the non-perturbational method is also pointed out. These general considerations are applied to find out the interaction effects in the multiple production phenomena, which have been disregarded in Fermi–Landau's statistical theory. A.

530.145

7578. THE COVARIANT PHENOMENOLOGICAL QUANTUM THEORY OF THE ELECTROMAGNETIC FIELD IN A DIELECTRIC. Č.Muzikář.
Czech. J. Phys., Vol. 6, No. 5, 409-20 (Oct., 1956). In German.

In an explicitly covariant formulation, the potential A_μ is expressed in the form $a_\mu + \phi u_\mu$, where the 4-vector u_μ defines the motion of the frame S relative to the dielectric rest-frame S^0, and a_μ is orthogonal to u_μ. The gauge condition used reduces to $\operatorname{div} \vec{A} = 0$ in S^0. Two alternative definitions of the momentum 4-vector, involving 3-space integration in S and in S^0 respectively, are shown to be equivalent for divergence-free energy momentum tensors, and momentum and energy eigenvalues are calculated in the cases of Minkowski, radiation and Abraham tensors. The relation of the theory to Schwinger's theory of vacuum fields is considered. R.A.Newing

530.145

7579. ON SOME NEW METHODS TO REMOVE THE DIVERGENCES IN QUANTUM ELECTRODYNAMICS. N.S.Kalitsin.
Izv. Bulg. Akad. Nauk., Vol. 5, 37-66 (1955). In Bulgarian, with summaries (4 pp.) in Russian and (4 pp.) in German.

An invariance under change of sign of the energy, i.e. under $m \rightarrow -m$, positive frequencies → negative frequencies, etc., is postulated. The vacuum is defined as a state of zero energy, momentum, and charge. The interaction of the electromagnetic field with the electron–positron field is considered, with special attention to the negative energy states, and all of the results of the old quantum electrodynamics are rederived. G.E.Brown

530.145

7580. INTERACTION OF A NUCLEON WITH THE MESON FIELD. N.S.Kalitsin.
Izv. Bulg. Akad. Nauk., Vol. 5, 213-29 (1955). In Bulgarian, with summaries (1 p.) in Russian and (1 p.) in German.

A new equation

$$[\beta_\mu (\frac{\partial}{\partial x_\mu} - \frac{g}{6} \beta_\nu \beta_\sigma \varphi_{\mu\nu\sigma}) + m_0]\Psi = 0;$$

$\mu, \nu, \sigma = 0, 1, 2 \ldots 5$ is proposed, where φ is the tensor potential of the meson field and the β's are 8 by 8 matrices. Since this system does not contain derivatives of the field, it is similar to quantum electrodynamics in the respect that it can be renormalized. G.E.Brown

530.145

7581. A SPECIAL REPRESENTATION FOR THE TREATMENT OF A SYSTEM OF TWO DIRAC PARTICLES.
H.Joos, J.L.Ferreira and A.H.Zimerman.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 57-64 (Jan., 1957).

It is shown that in a representation where, besides angular momentum and parity, the radial velocities of two Dirac particles are also diagonal, the radial eigenvalue equations for the energy reduce to a system of four simultaneous differential equations. The usefulness of this representation is shown in the case of the Breit equation. A.

530.145

7582. NON-LOCAL MODELS OF PION–NUCLEON, PION–HYPERON INTERACTIONS. P.Budini and L.Fonda.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 666-83 (March, 1957).

Starting from the hypothesis that the pion interacts with nucleons and hyperons only through intermediate fields, non-local covariant models of pion–nucleon, and pion–hyperon interactions can be obtained after formal elimination of the intermediate fields. First a simple mathematical model is discussed which admits exact solutions. This model has some formal features in common with the Pais–Uhlenbeck non-local theory but avoids the non-definite energy difficulty. From this model a static nucleon–nucleon potential is obtained which exhibits a core effect in the central part and no divergence in the tensor part. Then a physical model is suggested in which the internal field is represented by a couple of K-mesons of opposite parity. A linear approximation of this model is equivalent to a non-local form factor theory of pion–nucleon pion–hyperon interactions of the Kristensen–Møller type in which the Fourier transform of the form factor is, however, of a class more general than that of the algebraic functions. A theory started from this form factor Lagrangian exhibits general convergence features which are briefly discussed. In this linear approximation, relations between the K–nucleon–hyperon and pion–nucleon, pion–hyperon coupling constants, are obtained. A.

530.145

7583. STATISTICAL APPROACH TO THE DOMAIN OF ACTION OF COLLECTIVE CO-ORDINATES IN THE MANY BODY PROBLEM. J.K.Percus and G.J.Yevick.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1057-73 (May, 1957).

The collective coordinates have a mathematical boundary whose nature is investigated. This is accomplished by comparing expressions for the partition function in collective coordinate space and configuration coordinate space. The resulting decomposition of the collective space into two-dimensional subspaces, whose extent is independent of wave-number, permits approximation to many body correlations. It also implies a new simple approximation to the many body partition function, some consequences of which are examined. A.

530.145

7584. BOUNDS ON PHASE SHIFTS. J.B.Keller.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1122-7 (May, 1957).

It is shown that for certain potentials, the W.K.B. method yields a lower bound for the exact phase shift, and for some other potentials it yields an upper bound. Another method for obtaining bounds is also described. A.

530.145

7585. THE COUPLING CONSTANTS OF STRONG INTERACTIONS. P.T.Matthews and A.Salam.
Nuclear Physics, Vol. 2, No. 5, 582-5 (Jan., 1957).

Some formal restrictions are imposed on the strong interaction between elementary particles, which considerably reduce the number of independent interactions constants which appear in the theory of d'Espagnat and Prentki. A.

530.145 : 539.18

7586. ROLE OF STRONG INTERACTIONS IN DECAY PROCESSES. S.Weinberg.
Phys. Rev., Vol. 106, No. 6, 1301-6 (June 15, 1957).

An attack is made on the problem of determining which are the primary interactions that contribute to decay processes. It is necessary first to understand the role of the strong interactions in these processes; this has proven difficult in the past because of the appearance of infinities. It is shown that all infinities appearing in decay processes involving nucleons, pions, photons, and one lepton pair may be removed by renormalization to all orders in the strong and electromagnetic coupling constants. The necessary and sufficient condition for renormalizability is that the primary interactions that actually exist in nature form one of certain subclasses of a class of fourteen possible primary interactions. In particular, from this point of view it is incorrect to treat the π-meson decay as proceeding via Fermi interactions only. Two incidental results of this work are that the use of perturbation theory in computing the contribution of the pion decay interaction to μ-meson absorption is justified, and that the "principle of minimal electromagnetic coupling" is violated in the radiative tensor decay of the π-meson. A.

530.145

7587. WEAK DECAY INTERACTIONS. F.Coester.
Phys. Rev., Vol. 107, No. 1, 299-300 (July 1, 1957).

The time-reversal properties of a weak-decay Hamiltonian affect the possible observation of interferences. This effect is discussed and a general proof for a theorem by Lee, Oehme, and Yang is given (see Abstr. 5050/1957). A.

530.145 : 539.165.2

7588. WEAK INTERACTIONS BETWEEN "OLD" PARTICLES AND BETA DECAY. L.Michel.
Rev. mod. Phys., Vol. 29, No. 2, 223-30 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). An exhaustive critical review, previous to the discovery of non-conservation of parity, discussing which of the five possible Fermi couplings exist in nature and with what relative magnitude. Allowed transitions tell us that probably $g_V = g_A = 0$, and that g_S and g_T are preponderant and have the same order of magnitude. Conclusions based on forbidden transitions are less reliable, but broadly confirm these conclusions; the question of the value of g_P is still open. Evidence is also discussed that the same Fermi coupling exists if one has the μ-meson instead of the electron, but the π-meson decay cannot be accounted for within this framework; theoretical attempts at justifying the form of the coupling are mentioned, as well as indications that there are in nature both neutrinos and anti-neutrinos; the purely phenomenological character of the theory is stressed. L.Pincherle

530.145

7589. MATRIX FORMULATION OF THE VECTOR FIELD AND OF THE FIELD OF MAXIMUM-SPIN 1 AND COMPARISON OF THEIR INTERNAL STRUCTURE. K.-H.Tzou.
C.R. Acad. Sci. (Paris), Vol. 244, No. 16, 2137-40 (April 15, 1957). In French.

See Abstr. 5843-4 (1957). The vector field and the field of maximum-spin 1 of the theory of fusion are formulated in the same matrix representation. The difference between the two fields is then precisely stated as regards their internal structure with respect to the states of spin. A.

530.145

7590. ON CLASSICAL FLUIDS WITH SPIN. G.Lochak.
C.R. Acad. Sci. (Paris), Vol. 244, No. 18, 2291-3 (April 29, 1957). In French.

Further discussion of the topics dealt with in Abstr. 910, 4819 (1956). P.M.Davidson

530.145

7591. FERMI FIELDS AND SPINORS OF UNBOUNDED REGIONS. Yu.A.Gol'fand.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 1, 68-70 (1957). In Russian.

The functional equations governing the Green function of a Fermi particle are formulated for a general extended field. When the field functions are spinors the S-matrix may be obtained by a functional integration of these equations. J.W.Gardner

530.145

7592. SYMMETRICAL FORM OF ELECTRON QUANTUM MECHANICS. R.Zaĭkov.
Izv. Bulg. Akad. Nauk., Vol. 5, 3-26 (1955). In Bulgarian with summaries (1 p.) in Russian and (1 p.) in German.

Proca (Ann. Phys. (Paris), Vol. 20, 347, 1933) has given a completely relativistic-symmetric quantum mechanics for free electrons. The present work extends Proca's theory to electrons in external fields. Consideration of the interaction between the electron and the pseudo-scalar meson field leads to relations between the bilinear field quantities in Minkowski space—time. Finally a nonlinear equation is established for the meso-electron field. J.W.Gardner

530.145 : 537.534.74

7593. STRUCTURE OF THE PROTON AND ELECTRON–PROTON SCATTERING. L.Tenaglia.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 229-41 (Jan., 1957). In Italian.

Starting from the fixed source theory, the charge density of the pion cloud surrounding the proton and its magnetic moment are calculated. These densities enable one to determine the differential cross-section for electrons scattered elastically from the proton. That is done for 188 MeV electrons. For higher energy electrons a useful formula is given, taking into account that, in this case, a small part only of the pion field contributes to the scattering. A.

530.145

7594. ON THE PROPERTIES OF SPIN 2 PARTICLES. T.Regge.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 325-36 (Feb., 1957).

A theory of spin 2 particles has been worked out. The wave equations are first order and a symbolic approach which is developed permits easy computation of quantities of physical interest. An interesting application of the sum rules for spin 2 particles is the calculation of the Coulomb scattering in relativistic Born approximation. The theory is also applied to calculate the decay of a spin 2^+ particle into three pseudoscalar particles and into two Dirac particles. The bearing of the decay calculations on the spin 2^+ hypothesis for the K-meson is discussed. A.

530.145

7595. DISPERSION RELATION FOR NONRELATIVISTIC PARTICLES. D.Y.Wong.
Phys. Rev., Vol. 107, No. 1, 302-6 (July 1, 1957).

It is shown that if the wave-function of a nonrelativistic particle satisfies the Schrödinger equation with a velocity-independent potential, then its scattering amplitudes (and the S matrix in general) satisfy the same dispersion formulae as those derived for the scattering of light. In the present derivation, the validity of a perturbation expansion and certain integrability of the potential are assumed, and the requirement of the outgoing wave Green's function replaces the condition of strict causality for the scattering of light. The scattering amplitude for fixed momentum transfer is also shown to satisfy the dispersion relations. Together with the unitarity of the S matrix, the complete S matrix is determined by the Fourier transform of the potential through an iterative procedure using the dispersion relations. If the potential possesses bound states, then all the dispersion formulae are modified to include residue terms corresponding to singularities on the positive imaginary axis of the momentum plane. The necessity of these modifications is related to the divergence of the perturbation series for small wave-numbers. Essential singularities of the S matrix due to exponentially damped potentials give no additional contribution to the dispersion formulae. A.

530.145

7596. REFORMULATION OF THE MAJORANA THEORY OF THE NEUTRINO. K.M.Case.
Phys. Rev., Vol. 107, No. 1, 307-16 (July 1, 1957).

The Majorana theory for a particle with mass is reformulated in terms of a two-component field. In this form it is seen that the theory goes over continuously to the Weyl-type two-component equation as the mass tends to zero. The asymmetries obtained in β and μ decay experiments are shown to imply only that the neutrino mass is small — not that it is zero. Also the asymmetries are shown to be no more implied by the use of a two-component theory than by the use of a four-component one. Two-component theories do imply certain relations between mass, parity nonconservation, and double β decay. That there are asymmetries is due to the fact that the interactions necessary to describe the physical world are not reflection-invariant. A.

530.145

7597. ON A THEORY OF A COMPOSITE MODEL OF ELEMENTARY PARTICLES. Z.Maki.
Progr. theor. Phys., Vol. 16, No. 6, 667-83 (Dec., 1956).

It is shown that the composite model of elementary particles proposed by Sakata can be formulated as a covariant theory of bound states. The forces among fundamental particles (nucleons and Λ-particles) from which the composite pions, heavy mesons and hyperons are supposed to be constructed are derived from the assumed basic interactions of Fermi type. Equations for bound states are solved by the lowest order approximation (the chain approximation) with the cut-off device. A.

530.145

7598. PRESENT KNOWLEDGE ABOUT THE NEW PARTICLES. C.N.Yang.
Rev. mod. Phys., Vol. 29, No. 2, 231-5 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). Surveys the field of elementary particle theory and experiment in a general way (strong and weak interactions, symmetry properties, etc.). Lists the topics currently of interest to theoreticians, with particular reference to parity. Points out that of the six known conservation laws only two (energy and momentum) can be regarded as experimentally proved for weak interactions. Suggests that for all interactions the product of parity and charge conjugation may be conserved, thus conserving universal symmetry in a more generalized sense. R.H.W.Johnston

530.145

7599. A PARTICLE OF SPIN 3/2 IN AN ELECTROMAGNETIC FIELD. É.E.Fradkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 363-5 (1957). In Russian.

A particular relativistic equation, consistency relations, normalization and the related Hamiltonian are discussed. G.E.Brown

530.145 : 539.153.4

ON THE KINEMATIC PROPERTIES OF A SYSTEM OF TWO DIRAC PARTICLES. See Abstr. 7307

530.145

7600. A STUDY OF NUCLEON FORCES WITH REPULSIVE CORES. III. LOW ENERGY PROPERTIES OF THE LÉVY POTENTIAL. M.A.Preston and J.Shapiro.
Canad. J. Phys., Vol. 35, No. 4, 451-4 (April, 1957).

For Pt II, see Abstr. 4822 (1956). An attempt has been made to select the core radius and coupling constant of the Lévy potential for the interaction of two nucleons in order to fit the binding energy of the deuteron and the singlet state neutron–proton scattering length. It was found that these two quantities cannot be fitted simultaneously. For any given choice of coupling constant, a somewhat larger core radius is required to fit the deuteron binding energy than is required for the scattering length. This spin dependence of the core radius does not preclude the possibility of a fit to the low energy data with the Lévy potential. A.

530.145

7601. ON THE FORMATION OF HEAVY PARTICLES IN HIGH-ENERGY COLLISIONS. S.Z.Belen'kiĭ.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 4, 523-6 (1954). In Russian.

The investigation is carried out on the basis of the Landau theory (Abstr. 5771/1954) of the thermodynamics of these processes, and under the assumption that the distribution in number and energy of the particles created in the collision only becomes defined when a "critical" temperature T_c is reached. To create a relevant fraction of heavy particles (so as to fit the experimental results) it is necessary to take kT_c of the order of $m_\pi c^2$ (m_π being the mass of the π-meson). The distributions in number and energy are tabulated for various values of T_c and for different types of heavy particles, as ratio of the number (and energy) of heavy particles to the number (and energy) of π-mesons. G.Martelli

530.145

7602. FERMI COUPLING AND MASS AND CHARGE SPECTRA OF BOSONS. B.Jouvet.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 1-20 (Jan., 1957).

An equivalence theorem is demonstrated between the theory resulting from a scalar Fermi self coupling, and a Yukawa theory postulating a boson coupled with a fermion pair; mass and coupling of this meson have to satisfy equations which are conditions on the meson renormalization constants. It is then shown that the Fermi theory is renormalizable, in the whole. Analysis of the infinities in perturbation theory is given, in view of their subtraction. Effective methods for the treatment of Fermi theory are given; their practical use is exemplified. Finally the magnitude of the boson renormalization constant is discussed. A.

530.145

7603. INTEGRAL EQUATIONS FOR MESON FIELD THEORY. R.L.Mills.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 30-44 (Jan., 1957).

A covariant method of approximating the nucleon Green's function S'_F is described, in terms of the solution of a connected sequence of linear integral equations. Explicit expressions for the matrix elements for processes involving only one real nucleon are derived by formal functional differentiation of S'_F with respect to external boson fields. The solution is renormalized, in the sense that its power series expansion in the coupling constant g is the same that obtained by enumerating Feynman diagrams and renormalizing term by term. Closed loops are neglected, though virtual nucleon pairs not corresponding to closed loops are included. A.

530.145

7604. FURTHER DEVELOPMENT OF A NEW APPROXIMATE ONE-VELOCITY THEORY OF MULTIPLE SCATTERING. C.C.Grosjean.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 83-101 (Jan., 1957).

In two preceding papers (Abstr. 6360, 8586/1956) dealing with a new approach for solving one-velocity multiple scattering problems in infinite homogeneous media, approximations for the particle density and current have been derived and studied in detail. Within the framework of the same formalism, the present article concerns the calculation of five further terms in the spherical harmonics expansion of the angular density. From a complete spherical harmonics analysis of the well-known transport equation three rigorous continuity conditions relating the unknown coefficients to the density and the current components are derived. In the special case of an isotropic point source, these equations reduce to one single equation and the propounded problem can be solved without great difficulty due to the existing symmetry properties. The solution is then generalized to the case of a given distribution of isotropic sources and both the "direct beam" and the "scattered" contributions to the various coefficients are calculated. The results have all been obtained in the case of slightly non-isotropic scattering, which evidently includes isotropic scattering as a special case. They are finally introduced in the expansions of the scattered particle density and the total density. These formulae will play an important role in a further extension of the new formalism to finite medium problems. A.

530.145

7605. ON THE Λ–NUCLEON FORCE AND THE BINDING ENERGY OF THE LIGHT HYPERFRAGMENTS. N.Dallaporta and F.Ferrari.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 111-22 (Jan., 1957).

The problem of the binding of a Λ-particle in nuclear matter is considered, assuming that the force acting between Λ and nucleon is due not only to the K-field but also to the π-field; the interaction schemes are: $\Lambda \rightarrow N + \bar{K}$, $N \rightarrow \Lambda + K$, $N \rightarrow N + \pi$, $\Lambda \leftrightarrow \Sigma + \pi$. The calculations are done assuming the d''Espagnat and Prentki Hamiltonian, with both scalar and pseudovector coupling (spin of the Λ and the Σ equal ½). A good fit to the experimental values for the binding energy of the Λ in light hyperfragments is obtained, if one assumes that the interaction constants for both the π and K-forces are of the same order of magnitude as the coupling constant of the ordinary nuclear forces: with this assumption the π-force turns out to be the more important for the binding. A

530.14

7606. ON SCATTERING AT VERY HIGH ENERGIES. K.Symanzik.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 659-65 (March, 1957).

The asymptotic behaviour of the scattering amplitude at very high energies is discussed on the basis of the general dispersion relations and the unitarity requirement. The assumption that the tangent approximation fulfills the dispersion relation leads to the prediction that the total cross-section can asymptotically not increa as strongly as proportional to the laboratory energy. The relevanc of this result is discussed. A

530.14

7607. ON THE SCATTERING OF PARTICLES BY A FORCE CENTRE ACCORDING TO THE RADIATION DAMPING THEORY. A.Sokolov and B.Kerimov.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 921-39 (April, 1957).

The elastic scattering of particles by a force centre at rest is investigated with the help of the radiation damping theory. Formul are obtained both for the effective cross-sections and for the phase shifts of the scattering by the short-range force centre. In conclusi a comparison is given for the formulae obtained by different metho A

530.14

7608. A SYSTEM OF GENERAL RELATIVISTIC EQUATIONS OF LOW TYPE. R.Omnes.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 983-93 (April, 1957).

Using Bogoliubov's methods a new demonstration of the Low equation is given, thus displaying its general character. The meth has been extended to give a set of equations of Low type for the pro ductions of mesons by mesons and one nucleon. A

530.1

7609. A KINEMATICAL TEST FOR THE RELATION BETWEEN THE COUPLING CONSTANTS IN MESON THEORY. K.Hiida.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1094-106 (May, 1957).

Using the approach to a solution of the quantum field theory presented by Landau and co-workers, the relation between the renormalized and unrenormalized coupling constants, in S(S) and PS(PS) meson theories, is re-examined. A kinematical method to test this relation, without calculating directly divergent integrals, is presented, using the properties of the isotopic spin operator. With this method, it is shown, in S(S) and PS(PS) meson theories, that the relation between the coupling constants obtained by the use of their method can not give correct information about the quantum field theory.

530.1

7610. INTRODUCTORY REMARKS ON MESON THEORY. H.Yukawa.
Rev. mod. Phys., Vol. 29, No. 2, 213-15 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). The author discusses present problems in meson theory, and suggests a theory of fundamental particles involving "internal" as well as "external" wave-functions. J.W.G.Wign

530.1

7611. PI MESODYNAMICS. F.E.Low.
Rev. mod. Phys., Vol. 29, No. 2, 216-22 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). The author reviews attempts to predict the behaviour of the cross-sections for scattering by nucleons of pions having energies of les than 300 MeV on the basis of the relativistic symmetric pseudosca theory and the Chew static theory, and discusses other related pro blems. J.W.G.Wigna

530.1

7612. POLARIZATION OF PARTICLES OF SPIN ONE AND ELASTIC SCATTERING ON SPIN-ZERO NUCLEI AT LOW ENERGIES. S.Watanabe.
Rev. Mexicana Fís., Vol. 6, No. 2, 59-71 (April, 1957). In Spanish

The polarization of a beam of spin-one particles after an elastic scattering by spin-zero nuclei at low energy was studied. The transition matrix $M(\theta,E)$ is determined using Lepore's metho assuming the spin–orbit term in the Hamiltonian, but not the tens

force since the nuclei have spin zero. The result is that, if the incident beam is polarized the differential cross-section of the elastic scattering is a sum of three terms. The first is independent of the incident and outgoing beams; the second term is a scalar product of the polarization vectors of the incident and outgoing beams, and third one is the scalar product of the tensors of polarization of the two beams. This result suggests two types of double scattering. One is to be carried out in the same scattering plane, and the other in two orthogonal planes i.e. the differential cross-section of the second scattering must be measured in the plane perpendicular to the first scattering plane. In the former double scattering an azimuthal asymmetry is found, whereas in the latter, none. If it is assumed that the spin-one nuclei namely the deuteron, Li_6 and N_{14} behave as a whole, i.e. that each component of these nuclei does not interact directly with the scatterer, then the treatment developed here must be applicable to the elastic scattering of the spin-one nuclei by spin-zero nuclei. A.

530.145

7613. CONSTRUCTION OF A PHENOMENOLOGICAL SCATTERING MATRIX WITH NONLOCAL INTERACTION. V.S.Barashenkov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 368-9 (1957). In Russian.

It is shown that a unitary S-matrix, which is macroscopically causal, can be constructed, having a form factor at each vertex. G.E.Brown

530.145 : 538.122

7614. THE INFLUENCE OF A LONGITUDINAL FIELD ON THE MULTIPLE SCATTERING OF PARTICLES. N.A.Chernikov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 389-90 (1957). In Russian.

The problem of multiple scattering of a parallel beam of relativistic particles in a medium where a uniform magnetic field acts parallel to the beam is considered. It is shown that, other things being equal, the beam is narrower in the presence of the field. When the latter is absent there is a radial "polarization" of the beam, while when it is present the axis of the "polarization" is turned through an angle. S.Chomet

530.145

7615. MOMENTUM DISTRIBUTION OF INTERACTING FERMI PARTICLES. A.B.Migdal.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 399-400 (1957). In Russian.

Excited states are described in terms of quasi-particles above the Fermi sea. The analytical behaviour of the single-particle Green's function is discussed. G.E.Brown

530.145

7616. ON THE THEORY OF SCATTERING OF PARTICLES BY NUCLEI. I.G.Ivanter and L.B.Okun'.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 402-3 (1957). In Russian.

A brief note on the work of Hayakawa et al. (Abstr. 3194/1956) and Goldberger (Abstr. 1178/1949). The case is considered where the mass of the scattered particle is not equal to the mass of a nucleon. S.Chomet

530.145

7617. ON THE REPRESENTATION OF ELEMENTARY PARTICLES BY WAVE-FUNCTIONS SATISFYING NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS. G.Petiau.
C.R. Acad. Sci. (Paris), Vol. 244, No. 21, 2580-3 (May 20, 1957). In French.

This paper extends previous work (Abstr. 6908/1957) and gives an example of a wave-equation leading to a quantization of the mass. P.M.Davidson

530.145

7618. THE FORMATION OF ANTISYMMETRIC WAVE FUNCTIONS. L.E.H.Trainor.
Canad. J. Phys., Vol. 35, No. 5, 555-61 (May, 1957).

The problem of forming antisymmetric wave-functions is discussed, and it is shown that a convenient method developed previously by the author leads to the usual results. A.

530.145

7619. SOLUTION OF A SCHRÖDINGER EQUATION PROBLEM IN AN INFINITE THREE-DIMENSIONAL SPACE. M.Burnat.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 2, 224-7 (1957). In Russian.

The question of the existence and uniqueness of solutions describing scattering is handled in the case where the potential has singularities. The proof is carried out by investigating the kernel of the resolvent. A number of properties of the resolvent are proved and its kernel is evaluated in the region of singular points. G.E.Brown

530.145

7620. THE CROSS-SECTION THEOREM IN QUANTUM MECHANICS. D.Park.
Indian J. theor. Phys., Vol. 3, No. 2, 83-8 (June, 1955).

Gives the most general statement and proof of the relation between total cross-section and forward scattering amplitude. The relation is shown to hold regardless of the nature of the transitions which occur, provided only that the entire system can be described by a normalizable-state function. Examples are given showing how to find the explicit formula in situations where exchange is involved. A.

530.145

7621. GENERAL RELATIVISTIC INTERPRETATION OF SOME SPINOR WAVE EQUATIONS. F.Gürsey.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 154-71 (Jan., 1957).

The non-linear conform-invariant spinor wave-equation proposed in an earlier paper (Abstr. 4842/1956) is given a simple geometrical interpretation within the frame of general relativity. At each point of a conformal space-time manifold, an orthogonal frame of reference is defined, this frame being associated with a 4-spinor ψ. It is shown that if the contracted torsion tensor Λ_α relative to the frame vanishes (as in the case of a co-ordinate transformation) and the pseudo-vector L_α derived from the same torsion tensor remains constant and space-like, then the associated 4-spinor ψ satisfies just the above mentioned wave-equation which, in turn, determines the orthogonal frame of reference at every space-time point to within a conformal transformation of the co-ordinate system. In particular, if the pseudo-vector L_α also vanishes one obtains Dirac's equation for a particle of rest mass zero. In a discussion of the physical meaning of the orthogonal frame of reference, the time-like basis vector and one of the space-like basis vectors are respectively related to the current density and the the spin density 4-vectors associated with the wave-equation. A.

530.145

7622. MANY-BODY PERTURBATION THEORY. W.Tobocman.
Phys. Rev., Vol. 107, No. 1, 203-8 (July 1, 1957).

The usual perturbation treatment of the many-body problem is modified by eliminating the two-body interaction and introducing in its place a t matrix. The Watson, Brueckner, and Bethe (W.B.B.) treatment of the many-body problem is shown to be a special case of the modified perturbation treatment. The modified perturbation treatment involves no assumption except that of supposing the convergence of the perturbation expansion. Thus to each order in the expansion the results must be meaningful and no unphysical "unlinked cluster" terms can appear. Within the framework of the modified perturbation treatment it is easy to interpret the concepts of the Pauli principle for intermediate states and the self-consistent choice of the comparison potential which play such an important role in the W.B.B. treatment. This work is similar to that of J.Goldstone in that it relates the W.B.B. treatment to a perturbation treatment of the many-body problem. It differs from Goldstone in that it uses the usual time-independent perturbation theory instead of the time-dependent one. The time-independent approach permits a direct comparison with the W.B.B. treatment and facilitates discussion of the Pauli principle for intermediate states and of the self-consistent potential. A.

530.161

7623. IRREVERSIBLE PROCESSES IN PHYSICAL THEORY. E.L.Hill and A.Grünbaum; K.R.Popper.
Nature (London), Vol. 179, 1296-7, 1297 (June 22, 1957).

The first two authors give a statement of the view that irreversible processes associated with infinite systems (e.g. light emission) are basically responsible for irreversibility. References are given to recent philosophical work on the subject. Popper registers qualified agreement but notes the distinction between the infinite systems constituted by a radiating atom (irreversible) and a planet in a hyperbolic orbit (reversible). R.O.Davies

530.162

7624. TIME CORRELATION IN CLASSICAL STATISTICAL SYSTEMS COMPOSED OF A LARGE NUMBER OF INTERACTING PARTICLES. V.V.Tolmachev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 5, 842-5 (1957). In Russian.

The changes, in time, of the condition of a system of interacting particles are studied by means of the method of "linked distribution functions". It is suggested that the results obtained might apply to a real gas. N.L.Johnson

530.162

7625. THE GENERALIZED PROBLEM OF THE STOCHASTIC MOVEMENT OF PARTICLES. N.A.Chernikov.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 6, 1030-2 (1957). In Russian.

An extension of the standard methods of studying the stochastic movement of particles to allow for relativity and/or gravitational effects. The methods are described in general terms only.
N.L.Johnson

530.162

7626. ON THE REGRESSION OF FLUCTUATIONS. M.Fixman.
J. chem. Phys., Vol. 26, No. 6, 1421-6 (June, 1957).

Both the formal and molecular aspects of fluctuation theory are considered with the aim of computing transport coefficients. The formal theory of the regression of fluctuations is presented from the standpoint of least-square linear prediction theory. Thereby the transport coefficients are expressed in terms of correlations between fluctuations and time averaged fluxes. The necessary dynamics is developed with the assumption that the potential energy of interaction between a small group of molecules and the rest of the system decays only slightly during the minimum time interval required to establish the flow processes. The theory is briefly illustrated with an application to diffusion. A.

530.162 : 532.7

7627. INTEGRAL EQUATION METHOD FOR DETERMINING APPROXIMATE FLUID DISTRIBUTION FUNCTIONS. J.C.Poirier.
J. chem. Phys., Vol. 26, No. 6, 1427-39 (June, 1957).

A general method for determining distribution functions in fluids is presented. The method consists of expanding the distribution function for a partially coupled subset of particles in the system in a multiple Taylor's expansion in the coupling parameters. The resulting set of linear integral equations may be solved by using an approximation less drastic than the superposition approximation. In the next to lowest approximation, the radial distribution function is obtained analytically for point ions and for an exp-exp potential. A.

530.162

7628. ISOTROPIC ROTATIONAL BROWNIAN MOTION.
W.H.Furry.
Phys. Rev., Vol. 107, No. 1, 7-13 (July 1, 1957).

The Brownian motion of the orientation of any rigid body (sphere, set of rectangular axes, etc.) is calculated for the case of individual random infinitesimal rotations whose probabilities are independent of the direction of the axis of rotation (isotropic case). The calculations are carried out by means of quaternions; the more important formulae are also given in terms of the rotation angle and axis direction. The unit solution, or distribution of orientations arising from a specified initial orientation, is found as a series converging rapidly for not-too-small times. It turns out to be expressible in terms of a theta function, and thus there is also available a series converging rapidly for small times. The use of the unit solution as a propagation function is discussed briefly, and is illustrated by verification of the iteration property of the unit solution. A.

530.162

7629. TEMPERATURE DEPENDENCE OF DISTRIBUTION FUNCTIONS IN QUANTUM STATISTICAL MECHANICS.
I.Oppenheim and J.Ross.
Phys. Rev., Vol. 107, No. 1, 28-32 (July 1, 1957).

The Bloch equation is utilized to derive an integro-differential equation for the temperature dependence of the Wigner distribution function of a canonical ensemble. This equation is solved by two methods; one yields a power series in Planck's constant and the other a power series in the potential energy of the system. Transformation functions for the density matrix and the Wigner function are discussed and their possible application in the treatment of systems obeying Fermi–Dirac or Bose–Einstein statistics is investigated. A.

530.162

7630. ERGODIC THEOREM FOR INTERACTING SYSTEMS.
H.Ekstein.
Phys. Rev., Vol. 107, No. 2, 333-6 (July 15, 1957).

Von Neumann has proved a quantum-mechanical ergodic theorem which deals with a closed macroscopic system and macroscopic observables. Certain unsatisfactory features of this theorem are probably due to the overly-strong idealization of a completely closed system. Since the claims of statistical mechanics go beyond macroscopic systems, there is a need for a more general theorem. The present paper deals with a system of any number of degrees of freedom and with any observable, during interaction with a temperature bath. In order to avoid an assumption of randomness, the bath must be described explicitly and precisely by a time-independent Hamiltonian. The model of the bath is obtained by taking the Gibbs ensemble seriously, i.e., as a set of N identical systems interacting through a potential λV. The following theorem is proved. The time-average of the quantum mechanical expectation value of any observable with respect to any initial state is equal to its statistical average in the double limit $N \to \infty$, $\lambda \to 0$, for the overwhelming majority of all interaction potentials V. A.

530.162 : 539.11

7631. STATE VECTORS IN THE COLLECTIVE DESCRIPTION.
T.Nishiyama.
Progr. theor. Phys., Vol. 16, No. 3, 244-6 (Sept., 1956).

In the theories of collective description developed from that proposed by Bohm and Pines (Abstr. 1278/1954) subsidiary condition must be improved to prevent the existence of solutions representing fictitious states. It is here shown that one of these conditions may be transformed in a way which makes the state vectors more easily obtainable. P.M.Davidson

530.162

7632. STATISTICAL MECHANICS: A SURVEY OF RECENT LINES OF INVESTIGATION. L.Van Hove.
Rev. mod. Phys., Vol. 29, No. 2, 200-4 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). A brief survey of some recent work in equilibrium statistical mechanics (imperfect systems, liquids, phase transitions) and in non-equilibrium statistical mechanics (Boltzmann transport equation, approach to equilibrium). P.T.Landsberg

530.162

7633. FORCE FLUCTUATIONS IN AN ELECTRON GAS.
M.Ya.Mints.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 386-7 (1957). In Russian.

The concept of a correlation length, $\tau_0 \sim e^2/kT$, is introduced to discuss energy exchange between individual electrons of the gas, and assess the spatial extent of "local" fluctuations in energy density. J.W.Gardner

530.162

7634. THE GROUND STATE OF AN ELECTRON GAS. H.Koppe.
Z. Phys., Vol. 148, No. 2, 135-55 (1957). In German.

Using the method of second quantization, certain conditions on the density matrices are derived. Although they go beyond those used by Mayer (Abstr. 1498/1956), it is not certain that they are complete. An application to the problem of a spinless electron gas with Coulomb interaction bears out Heisenberg's assumption, in his theory of superconductivity, on the structure of the ground state of an electron gas (Abstr. 3203/1947). W.A.Hepner

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.25

7635. TWO-DIMENSIONAL PROBLEMS OF STRESS DISTRIBUTION DUE TO CERTAIN LOADS ON THE UPPER SURFACE OF AN ELASTIC LAYER OF NON-ISOTROPIC MATERIAL WITH RIGID BASE. P.Choudhury.
Indian J. theor. Phys., Vol. 3, No. 3, 111-18 (Sept., 1955).

531.2

7636. ON THE STRESS DISTRIBUTION IN AN INFINITE ELASTIC SOLID OF A TRANSVERSELY ISOTROPIC MATERIAL WITH A CYLINDRICAL HOLE DUE TO A LOCALISED AXIAL SHEAR. J.G.Chakravorty.
Indian J. theor. Phys., Vol. 3, No. 3, 119-24 (Sept., 1955).

531.2

7637. ON THE STRESSES IN TWISTED COMPOSITE SPHERES AND SPHEROIDS. S.C.Das.
Canad. J. Phys., Vol. 35, No. 7, 811-17 (July, 1957).

Stresses have been calculated in the cases of concentric composite elastic spheres and spheroids when they are twisted by couples. The results have been obtained in closed forms. A

531.381

7638. STRESSES IN A ROTATING BLADE BOUNDED BY TWO EQUAL CONFOCAL PARABOLAS. B.B.Chatterjee.
Indian J. theor. Phys., Vol. 3, No. 3, 107-10 (Sept., 1955).

The stresses in blades bounded by two equal confocal parabolas rotating about perpendicular axes through the centre and one of the points of intersection of the parabolas respectively are discussed. A.

MECHANICAL MEASUREMENTS 531.7

531.717.1

7639. ON THE MEASUREMENT OF FOIL-THICKNESSES BY ABSORPTION OF Co^{60}, Tl^{204}, Sr^{90}, and Ru^{106} β-RADIATION. T.-T.Ouang.
J. Phys. Radium, Vol. 17, No. 12, 1019-20 (Dec., 1956). In French.

Optimum thicknesses were: Co^{60}: 5-18; Tl^{204}: 20-100; Sr^{90}: 100-700; and Ru^{106}: 100-1500 mg cm^{-2}. A.O.Stanesby

531.752

7640. AN AUTOMATICALLY RECORDING VACUUM BALANCE. M.I.Pope.
J. sci. Instrum., Vol. 34, No. 6, 229-32 (June, 1957).

The apparatus described can record changes in weight of a solid, either in the presence of a gas or in vacuo, at temperatures of up to 1000° C, to an accuracy of ± 0.2 mg with a total range of approximately 5 g. Simplicity in construction is achieved by use of only standard radio and electrical components. Applications include thermogravimetric analysis, gas sorption and studies of gas-solid reactions. A.

531.787

7641. AN AUTOMATIC NULL METHOD RECORDING MANOMETER. H.R.B.Hack.
J. sci. Instrum., Vol. 34, No. 7, 280-2 (July, 1957).

A brief account is given of a simple method of maintaining the position of the mercury meniscus of a manometer within less than 1 mm when pressure changes across the meniscus occur at a rate of up to 1 cm of mercury per minute. The limits of movement of the meniscus are determined by electrical contacts inserted through the manometer wall. The balancing of a pressure change across the meniscus is effected by the movement of a mercury reservoir raised or lowered by the rotation of a bobbin controlled by an electromagnetic ratchet relay. Each movement of the reservoir is recorded by an electromagnetic hammer. A.

MECHANICS OF FLUIDS 532

532.137

7642. ON THE OSCILLATING CYLINDER VISCOMETER FOR ELASTIC LIQUIDS. II. Ali A.K.Ibrahim.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1208 (Nov., 1956).

The equation is given for the phase lag between the motion of the inner and outer cylinders when the latter is oscillated. It gives good agreement with the experimental results of Markovitz et al. Abstr. 8510 (1952). H.G.Jerrard

532.137

7643. A GRAPHICAL METHOD FOR DETERMINING THE COEFFICIENT OF VISCOSITY OF NEWTONIAN LIQUIDS USING AN OSCILLATING CYLINDER VISCOMETER. III. Ali A.K.Ibrahim.
J. Phys. Soc. Japan, Vol. 12, No. 4, 440 (April, 1957).

532.517

7644. A TENTATIVE EXPLANATION OF THE WEISSENBERG AND REINER EFFECTS BY POSTULATING THE EXISTENCE OF GYROSCOPIC PHENOMENA IN VISCOUS FLOW. E.Jabotinsky.
Bull. Res. Coun. Israel, Vol. 6A, No. 1, 65-76 (Oct., 1956).

Gyroscopic effects in viscous flow are postulated resulting in the splitting of the flow into separate spinning portions. The spin of each portion is given for incompressible flow by the gyro-spin equation which is used to show that the Weissenberg—Reiner effects can be expected for values of $\Omega^2 rh$ satisfying a double inequality. The radial distribution of pressures is predicted. A.

532.517

7645. THE EQUATIONS OF MOTION OF AN INCOMPRESSIBLE VISCOUS FLUID IN THE PARALLEL SYSTEM OF COORDINATES. L.Sanyal.
Indian J. Phys., Vol. 31, No. 1, 6-10 (Jan., 1957).

For a rigorous deduction of the equations of a three-dimensional boundary layer on a given surface, the Stokes—Navier equations of motion of an incompressible viscous fluid under no body forces have been transformed in the parallel system of coordinates. A.

532.517.4 : 536.24

7646. STEADY STATE HEAT TRANSFER TO FULLY DEVELOPED TURBULENT FLOW IN A CURVED CHANNEL. A.W.Marris.
Canad. J. Phys., Vol. 35, No. 4, 410-34 (April, 1957).

A vorticity transfer analogy theory of turbulent heat transfer is developed first for the case of fully developed turbulent flow under zero transverse pressure and temperature gradients such as that in the annulus between concentric cylinders rotating with different angular velocities or in a "free vortex". The mean flow is assumed to be two-dimensional. The theory, which requires that the turbulence be statistically isotropic, yields a temperature distribution in agreement with experiment except in narrow regions immediately adjacent to the boundaries. An argument is given to show that the boundary layer thickness should be of the order of the reciprocal of the square root of the mean velocity, these boundaries are introduced, and Nusselt moduli are defined and their dependence on Reynolds and Prandtl numbers is investigated. The temperature distributions for the case of non-zero transverse temperature and pressure gradients, i.e. for the case of flow in a curved channel in which the fluid does not flow back into itself, are then obtained and the applicability of the simpler equations for zero transverse gradients to this case is investigated. A.

532.517.4

7647. TURBULENT FLOW IN THE GAP BETWEEN TWO CYLINDERS, THE INNER OF WHICH ROTATES. J.Polášek.
Elektrotech. Obzor., Vol. 46, No. 2, 82-5 (1957). In Czech.

Based on previous published work, the author gives a semi-empirical expression for the time average of the velocity of a viscous fluid between two concentric cylinders. The following assumptions are made: The inner cylinder rotates at a constant angular velocity, the flow between the cylinders is turbulent, the velocity in the axial direction is zero. Mean velocity profiles are determined for published examples and for turbine alternators. Calculated results are compared with experimental data. E.Erdélyi

CAPILLARITY 532.6

532.61.08

7648. CAPILLARY CONE METHOD FOR DETERMINATION OF SURFACE TENSION OF SOLIDS.
A.Skapski, R.Billups and A.Rooney.
J. chem. Phys., Vol. 26, No. 5, 1350-1 (May, 1957).

The method which is described and which is superior to the wedge method (Abstr. 3525/1956) permits direct measurement of the curvature of the solid—liquid interface of a single crystal coexisting in capillary equilibrium with its melt. W.Good

532.613 : 536.7

7649. CURVED FLUID INTERFACES. III. THE DEPENDENCE OF THE FREE ENERGY ON PARAMETERS OF EXTERNAL FORCE. F.P.Buff and H.Saltsburg.
J. chem. Phys., Vol. 26, No. 6, 1526-33 (June, 1957).

For Pt II, see Abstr. 3050 (1957). The parameter of external force dependence of the free energy Ω appearing in the grand partition function is first illustrated on the basis of ideal gas models. In order to obtain a corresponding asymptotic estimate of Ω for real fluids in the presence of external fields, the earlier hydrostatic results are transcribed into thermodynamic terms. The resulting expression for Ω is shown to yield work elements in agreement with the detailed theory and, furthermore, when Ω is subjected to an appropriate variational principle the earlier relations describing the surfaces are obtained. These asymptotic formulae demonstrate that for macroscopic applications the classical equations are completely valid. Since these equations determine the spatial distribution of fluids, their connection with Duhem's theorem is described. A.

532.614.2

7650. THE SURFACE FREE ENERGY OF ICE. A.V.S.de Reuck. Nature (London), Vol. 179, 1119-20 (June 1, 1957).

The surface free energy (F) of ice was calculated using Rowlinson's model of the water molecule (Abstr. 4571/1951). For the basal plane F_B = 119 erg/cm^2, and for the prism face F_p = 128 erg/cm^2. J.Franks

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 539.152.2

7651. ANALYSIS OF HIGH-RESOLUTION N.M.R. SPECTRA. W.Anderson and H.M.McConnell.
J. chem. Phys., Vol. 26, No. 6, 1496-504 (June, 1957).

Van Vleck has shown the usefulness of moment calculations in the interpretation of magnetic interactions found in crystals. This approach has been extended to include liquids where separate resonances may be well resolved. In a simple chemical system containing only two groups of nuclei, this procedure allows the direct calculation of the spin coupling constant and the chemical shift in terms of directly measured quantities; in more complex systems, it allows some information to be obtained without finding the complete solution to a particular problem. A.

532.7

7652. LATTICE VACANCY THEORY OF THE LIQUID STATE. C.R.Mueller and D.C.Stupegia.
J. chem. Phys., Vol. 26, No. 6, 1522-5 (June, 1957).

Using the simple lattice vacancy or "hole" theory of the liquid state as a starting point, various modifications were investigated. The best partition function found involves changes only of the term (Na+Nb)!/Na!Nb! in the simple "hole" theory. Na and Nb are the number of molecules and holes, respectively. This model involves a change in analogy with the Flory approximation for solutions and corresponds roughly to utilizing holes one-third the size of molecules. For the usual average of the rare gases the critical temperatures are about 5% too high, critical volumes 27% too high, a PcVc/RTc about 8% too high. The slope of the plot of ln P/Pc v. Tc/T is about 5% in error. The slope of the rectilinear diameter plot is about 10% in error. Co-existing phase densities are reasonably good in the liquid region and, in addition, rather remarkable results are obtained for the vapour phase. The model has been extended to binary solutions and predicts the thermodynamic quantities of mixing quite well for the few cases where calculations have been made. A.

532.7 : 532.13

7653. RELATIONSHIP BETWEEN RELAXATION TIME AND VISCOSITY FOR WATER. E.H.Grant.
J. chem. Phys., Vol. 26, No. 6, 1575-7 (June, 1957).

The Debye relationship connecting relaxation time, viscosity, molecular size, and absolute temperature appears to hold almost exactly in the case of water. The Debye equation was formulated on the basic assumption that each molecule can be considered as turning in a viscous continuum as it rotates in dielectric relaxation, and it is well known that this molecular picture is inapplicable to water. It is shown that a similar relationship can be deduced directly from equations based on the hydrogen bonded structure of the liquid. A.

532.7 : 537.528

ELECTRIC STRENGTH AND LIQUID STRUCTURE. See Abstr. 6231

532.72

7654. FREE DIFFUSION: DIFFUSION COEFFICIENT VARYING EXPONENTIALLY WITH CONCENTRATION. D.M.Clarke.
J. chem. Phys., Vol. 27, No. 1, 29-32 (July, 1957).

An approximate solution to the Fick equation for free diffusion is derived in terms of the error integral and its first derivative for the case when the diffusion coefficient shows exponential variation with the concentration of the diffusing species. The results are discussed with reference to the skewed character of the concentration gradient. A.

532.77 : 541.64

7655. RELATIONSHIP OF THE SECOND VIRIAL COEFFICIENT TO POLYMER CHAIN DIMENSIONS AND INTERACTION PARAMETERS. T.A.Orofino and P.J.Flory.
J. chem. Phys., Vol. 26, No. 5, 1067-76 (May, 1957).

A useful approximation has been found for the excluded volume integral for the interaction of a pair of polymer molecules, represented by Gaussian distributions of chain segments about their respective centres of gravity. By means of this approximation, the theoretical expression for the second virial coefficient in the expansion of the osmotic pressure is represented over the entire range of polymer–solvent interaction by

$$A_2 = \text{const}\,([\eta]/M)\,\ln[1 + (\pi^{1/2}/4)\,X_1 + (\pi^{1/2}3^{3/2}/32)X_2].$$

X_1 and X_2 are related to the thermodynamic interaction parameters χ_1 and χ_2, respectively, in the semiempirical expression for the solvent chemical potential $\mu_1 - \mu_1^0 = RT[\ln(1 - v_2) + (1 - 1/x)v_2 + \chi_1 v_2^2 + \chi_2 v_2^3 + \ldots]$ where v_2 is the volume fraction of polymer and x the ratio of molar volumes of polymer and solvent. Inclusion of the higher term $\chi_2 v_2^3$ (and X_2) constitutes a refinement over the treatment previously published. It is shown that the influence of X_2 may be appreciable for low molecular weights and in poor solvents; its effect vanishes as the molecular weight becomes large. However, if $X_2 \neq 0$, the temperature at which A_2 for a given polymer–solvent pair becomes zero will, in general, depend upon the molecular weight. The similar influence of this term on the expression for the intramolecular expansion factor is smaller, although not necessarily negligible. Interaction parameters (χ_1) are calculated from second virial coefficients for a number of polymer–solvent systems, and these are compared with the χ_1 values obtained from intrinsic viscosities (intramolecular theory). The good agreement obtained offers strong evidence for the general validity of the intermolecular (A_2) and intramolecular theories. A_2 increases slightly more rapidly with decrease in M than theory predicts. On the whole, however, the consistency of results is gratifyingly good. The intrinsic viscosity increases linearly with A_2M in poor solvents. This relation must be replaced by one of approximate direct proportionality in good solvents. A.

532.77 : 530.162

7656. THEORY OF MULTI-COMPONENT FLUID MIXTURES. I. STATISTICAL ORDER–DISORDER ANALYSIS IN MULTI-COMPONENT FLUID MIXTURES.
Z.W.Salsburg, P.J.Wojtowicz and J.G.Kirkwood.
J. chem. Phys., Vol. 26, No. 6, 1533-41 (June, 1957).

Recent theories of solutions (Abstr. 4240, 7196/1956) have been developed without specific reference to a molecular model by the use of a corresponding states procedure which relates the properties of the solution to the properties of one of the pure components. These considerations have been based exclusively upon intuitive postulates which have been formulated by analogy from previous "cell" theories of solutions. The basis for a corresponding states treatment is examined in a rigorous manner by the use of statistical mechanics. A general method is given for reducing the multicomponent configurational partition function to a form peculiar to a system of one component. Two types of approximations to the rigorous theory that are amenable to numerical calculations are developed on a strictly mathematical basis, and are used to estimate the magnitudes of the correction terms to a corresponding states analysis. A

532.771 : 541.14

7657. THEORY OF DILUTE POLYMER SOLUTIONS. R.Koyama.
J. chem. Phys., Vol. 27, No. 1, 234-9 (July, 1957).

Assuming the pearl necklace model for a chain polymer molecule in a solution, the theoretical expressions for the mean intermolecular potential and the radial distribution function of polymer molecules are derived. The methods in the theory of Born and Green, which is based on the superposition approximation, are conveniently applied to the case of solution. The results show that the mean intermolecular potential is nearly approximated by the Gaussian function, and it depends on molecular weight and the temperature; the radial distribution function is also dependent on the molecular weight as well as on the temperature. At critical temperature where the second virial coefficient vanishes, the mean intermolecular potential vanishes and the radial distribution function assumes the constant value which is equal to unity. Theoretical expressions for the second and third virial coefficients are also given. A

532.783 : 539.2

7658. THE STRUCTURE OF LIQUID MONATOMIC METALS. H.Richter, G.Breitling and F.Herre.
Naturwissenschaften, Vol. 44, No. 5, 109 (1957). In German.

Discusses radial distribution functions of atoms of a number of liquid metals in relation to their coordination number in the solid state. A.R.Stoke

MECHANICS OF GASES 533

533.21

7659. COMPRESSIBILITY OF GASES. II. MIXTURES OF CARBON DIOXIDE AND HELIUM AT 30°C.
R.C.Harper, Jr and J.G.Miller.
J. chem. Phys., Vol. 27, No. 1, 36-9 (July, 1957).

For Pt I see Abstr. 4425 (1955). An investigation of the compressibility factors of gaseous mixtures of carbon dioxide and helium has been carried out at 30°C, using the Burnett method. The pressure measuring system included a visual high-pressure manometer. Results are expressed in an empirical regression formula from which approximations to the virial coefficients can be obtained. The interaction coefficient characteristic of bimolecular encounters between helium and carbon dioxide is in reasonably good agreement with the value calculated by Lunbeck and Boerboom from the properties of the pure gases alone. A.

533.5

7660. CONSIDERATIONS ON A THERMAL CONDUCTIVITY VACUUM GAUGE. W.Praxmarer.
Nachrichtentechnik, Vol. 7, No. 2, 61-5 (Feb., 1957). In German.

The operation of a thermal conductivity gauge consisting of a spherical negative-temperature-coefficient resistance element (thermistor) supported by thin wires within a glass envelope is treated theoretically and the optimum conditions for the construction of such a gauge for the range of 10^{-3} to less than 10^{-6} mm Hg are deduced. Numerical values are obtained by using a particular element as example. S.Weintroub

533.59

7661. VACTROLLER — A LABORATORY VACUUM CONTROLLER. C.J.Penther.
Rev. sci. Instrum., Vol. 28, No. 6, 460-3 (June, 1957).

Pirani gauges are used in an a.c. bridge circuit to sense deviation from the set point, and with the aid of a proportional leak valve, control the pressure of laboratory-scale vacuum systems over the range of 0.1 to 10 000μ of Hg. Pressure fluctuations from the controller action are negligible and stability of ±1% has been obtained over long periods without operator attention. Set point is easily adjustable by panel control knob. Commerical components are used except for the leak valve which is of special construction. A.

533.6.011.08

7662. PHYSICAL FOUNDATIONS OF MEASURING THE DIRECTION OF AN AIR STREAM AT HIGH SUBSONIC VELOCITIES BY MEANS OF A HOT WIRE. V.Bartošek.
Czech. J. Phys., Vol. 6, No. 5, 505-13 (1956). In Russian.

Presents the results of experiments carried out with a straight ("twin-pole") and a V-shaped ("three-pole") hot wire (Pt wire 30μ thick, W wire 20-30μ thick, lengths 4-7 mm) at M = 0.25-0.72. The sensitivity of the straight probe was almost zero when the wire was at right angles to the air-stream direction and attained about 2%/1° (resistance variation 2% per 1° angle change) within the range of 1-6° when relatively high heating currents were used, a lower sensitivity being obtained for weaker currents. With the V-shaped probe, the sensitivity was nearly uniform over the range ±4°; it did not depend on the air-stream velocity and was higher for smaller angles between the two wire legs (7-8°) than for larger angles (about 27°), the maximum sensitivity (for W wire) being ca. 10%/1°. F.Lachman

533.6.011.3 : 534.321.9

7663. STEADY ROTATIONAL FLOW GENERATED BY A SOUND BEAM. S.Tjötta.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 455-8 (April, 1957).

This is a theoretical study of the streaming generated by an ultrasonic sound beam in a fluid. A stream-function is introduced, and the differential equation giving it is solved by means of a Green's function. A.

533.6.011.311

7664. BOUNDARY-LAYER TRANSITION BY ROUGHNESS ELEMENT. I.Tani and H.Sato.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1284-91 (Dec., 1956).

Measurements were made on the boundary layer along a flat plate in a two-dimensional low-turbulence wind tunnel. A fine rod was attached to the plate as a two-dimensional roughness element, and the resulting transition from laminar to turbulent flow was investigated by hot-wire equipment. The transition was found to differ in marked contrast according as the height of roughness element k is small or large as compared with the thickness of the boundary layer δ_k at the element. When k/δ_k is small, the boundary-layer flow separates at the element, but reattaches to the plate at some distance producing scarcely any disturbance. Transition occurs in the reattached boundary layer. A sinusoidal velocity fluctuation, characteristic of the laminar-boundary-layer oscillation, is observed at a distance downstream from the roughness element. When k/δ_k is large, transition occurs in the separated layer before it reattaches to the plate. Within the separated layer, a sinusoidal fluctuation is observed having the frequency pertinent to the separated layer from a sharp corner. For a given roughness element at a given position on the plate, the transition moves forward and the transition Reynolds number continues to decrease as the free-stream velocity is increased. At a certain value of k/δ_k the transition reaches the element, and the transition Reynolds number begins to increase as the free-stream velocity is further increased. The minimum of the transition Reynolds number was found to correspond approximately to the demarcation of the two types of transition. A.

MOLECULAR THEORY OF GASES 533.7

533.7 : 530.145

7665. QUANTUM-MECHANICAL EFFECTS IN GAS DYNAMICS. E.V.Laitone.
J. chem. Phys., Vol. 26, No. 6, 1560-5 (June, 1957).

Recent analytical studies by Morgenstern led him to conjecture that the Boltzmann equation, describing the kinetic theory of a rarefied gas, cannot predict general spatially nonhomogeneous solutions. Morgenstern proposed a modified collision integral that can provide more general solutions, but still reduces to that of Boltzmann for the spatially homogeneous case. The present paper points out that this proposed collision integral can be made physically plausible by introducing recent contributions from the quantum-mechanical studies of transport processes by Ross and Kirkwood. However, it is indicated that when the higher order corrections beyond the Navier–Stokes order of approximation are to be considered then the density-dependent symmetry effects due to Bose–Einstein statistics, and other quantum-mechanical effects, in addition to the introduction of the scattering cross-section, may have to be included. A.

533.7

7666. KINETIC THEORY OF NONSPHERICAL MOECULES. II. C.F.Curtiss and C.Muckenfuss.
J. chem. Phys., Vol. 26, No. 6, 1619-36 (June, 1957).

In the previous part (Abstr. 1902/1956) the transport coefficients were expressed in terms of certain multidimensional integrals, the brace expressions. In the present discussion these integrals are considered in detail. The integrations over the linear and angular velocities are carried out explicitly and the problem is further reduced to an integral of geometrical parameters over the surfaces of two bodies. The resulting expressions for the transport coefficients apply to any rigid non-spherical convex body in which the centre of mass is a centre of symmetry. As an example, the final integrations are carried out explicitly for the sphero-cylindrical model. The shear viscosity, the bulk viscosity, and the thermal conductivity, for this model are presented as functions of two parameters characteristic of the shape and mass distribution of the molecule. A.

533.7

7667. HIGHER APPROXIMATIONS FOR THE TRANSPORT PROPERTIES OF BINARY GAS MIXTURES. I. GENERAL FORMULAS. E.A.Mason.
J. chem. Phys., Vol. 27, No. 1, 75-84 (July, 1957).

Higher approximations for the transport properties of binary gas mixtures are derived: (1) by the method of Chapman and Cowling; (2) by an extension of a method due to Kihara. Particular attention is paid to diffusion and thermal diffusion because of their importance in obtaining information on the forces between unlike molecules. The results can be used to test the convergence and accuracy of the theoretical formulae for various molecular models, and to supply higher correction terms if needed. A.

533.72

7668. ESTABLISHMENT OF CERTAIN PROBABILITIES AND MEAN VALUES, RELATING TO COLLISIONS AND FREE PATHS OF GAS MOLECULES. Kh.Khristov and N.Nikolov.
Izv. Bulg. Akad. Nauk., Vol. 5, 27-36A (1955). In Bulgarian, with summaries ($1\frac{1}{2}$ pp.) in Russian and ($1\frac{1}{2}$ pp.) in German.

Theoretical paper. Gas molecules are assumed to be perfectly

smooth spheres with no intermolecular forces except the elastic forces arising in collisions, and to possess constant temperature and density and with the gas not flowing. The probability is worked out for a gas molecule, moving with given velocity, to be involved in a short time in a collision and to have thereafter a velocity lying within a given range. An expression is also worked out for the number of collisions per unit time per unit volume. C.R.S.Manders

533.73 : 539.13

7669. THERMAL RELAXATION IN CARBON DIOXIDE AS A FUNCTION OF TEMPERATURE. F.D.Shields.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 450-4 (April, 1957).

Sound absorption and velocity measurements have been made in carbon dioxide between 0 and 200°C. The relaxation absorption was isolated by subtracting the tube and classical absorptions from the measured absorption. The Kirchhoff equations, which had been justified previously by measurements in A and N_2, were used to make these corrections. From the relaxation absorption were determined the temperature variation of the thermal relaxation time, the transition probability, and the collision efficiency. The results indicate that for the frequencies and pressures here employed the relaxation absorption and velocity effects are a function of f/p. This means that only binary collisions are effective in transferring energy between the vibrational and translational modes. The relaxation theory with a single relaxation time for all the vibrational modes adequately predicts the observed absorption and velocity. It is estimated that a separation in the relaxation times of the two lowest modes by a factor of more than two could not have gone undetected at 100°C. The temperature variation of the collision efficiency was adequately predicted by the Landau–Teller equation. A.

VIBRATIONS. ACOUSTICS 534

534.113

7670. A STUDY OF THE APPROXIMATE THEORY OF AN ELASTIC THICK BEAM. S.Higuchi, H.Saito and C.Hashimoto.
Canad. J. Phys., Vol. 35, No. 6, 757-65 (June, 1957).

The flexural vibration of a thick beam is analysed two-dimensionally by using the general equation of flexural motion. The characteristic equations and the frequencies of thick beams for the various end conditions are obtained and comparisons are made between the frequencies obtained from the present calculations and those from the elementary theory of a thin beam. A.

534.113

7671. DYNAMICS OF THE VIBRATION OF A BAR EXCITED BY TRANSVERSE IMPACT OF A HARD LOAD. I.
M.Ghosh and K.D.Ray.
Indian J. theor. Phys., Vol. 3, No. 2, 77-82 (June, 1955).

The dynamics of the vibration of a bar fixed at one end and free at other end, excited by transverse impact by a hard load at the free end is calculated. It is assumed that the bar behaves like a loaded bar so long as the load is in contact with it. The expression for the displacement at the point struck, pressure exerted by the load during impact, duration of impact and relative energy communicated to the bar by the impinging load, have been worked out. The variation of relative energy with the change of the mass-ratio of the bar and the load has been experimentally observed and the results agree well with the theory. A.

534.113

7672. DYNAMICS OF THE VIBRATION OF A BAR EXCITED BY TRANSVERSE IMPACT OF AN ELASTIC LOAD. II.
M.Ghosh and K.Ray.
Indian J. theor. Phys., Vol. 3, No. 4, 151-60 (Dec., 1955).

Deals with dynamics of vibration of a bar fixed at one end struck transversely by an elastic hammer at the free end. The bar is assumed to behave as a loaded bar so long as the hammer is in contact with it and the elastic hammer is conceived of as a perfectly hard hammer backed by a weightless spring. The expressions for the displacement at the point struck, pressure exerted by the load during impact, have been worked out. The case of a hard hammer has been deduced as a special case by putting the elastic constant of the hammer equal to infinity. The results obtained in Pt I (preceding abstract) are special cases. A.

534.131 : 537.228.1

7673. THE ELECTRICAL EQUIVALENT CIRCUIT OF DAMPED FLEXURAL VIBRATIONS IN PIEZOELECTRIC BARS. J.Tichý.
Czech. J. Phys., Vol. 6, No. 5, 443-52 (Oct., 1956). In Russian.

While dealing with the same subject as Chaloupka (Abstr. 3501/1955), the author allows for the internal friction and for the effect of gap between the electrodes and the ground surface of the piezoelectric bar. Having derived an equation for the friction-damped flexural vibrations of an infinitely thin bar, the author solves the equation of motion for forced flexural vibrations of a piezoelectric bar, calculates the mechanical deformations from the vibrations, and obtains the characteristics of the electrical equivalent circuit. F.Lachman

534.131

7674. VIBRATIONAL MODES ON BARIUM TITANATE CERAMIC DISKS. J.G.Martner.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 148-9 (Jan., 1957).

A method very similar to Kundt's tube has been applied to the study of modes of vibration at the surface of a barium titanate ceramic disk. The disk was covered with a film of carbon black suspended in water; when the disk was excited at one of its natural frequencies migration of the carbon black towards antinodal regions occurred producing a pattern on the surface. The migration to regions of high velocity is due to the Bernouilli pressure effect. By drying the disks permanent patterns for measurement have been obtained. T.C.Toye

534.154 : 621.315.612 : 621.317.391

7675. THE USE OF FERROELECTRIC CERAMICS FOR VIBRATION ANALYSIS. R.C.Kell, G.A.Luck and L.A.Thomas.
J. sci. Instrum., Vol. 34, No. 7, 271-4 (July, 1957).

The main advantage of ferroelectric ceramics of the barium titanate type for piezoelectric applications lies in their high dielectric constant, compared with the well-known single-crystalline piezoelectric materials such as quartz. Ferroelectric ceramics are used in accelerometers developed for the measurement of acceleration in vibration testing and in vibration strain gauges developed for the determination of the resonant frequencies of mechanical structures. The applications, construction and properties of these two devices are described. A.

534.21

7676. ELECTROSTATIC ANALOGY TO SOUND IN A REGION OF CONSTANT VELOCITY GRADIENT. L.Mittenthal.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 149-50 (Jan., 1957).

Using ray theory a wave-front is found for the case of sound from a point source in a medium where sound velocity is proportional to depth. The spreading backwards toward the source is shown to be independent of ray angle. The rays are shown to be harmonic functions similar to lines of flux. The harmonic conjugate to the ray is derived and shown to resemble an electrostatic potential. W.Bardsley

534.213 : 534.2

7677. FORMULATION OF WAVE PROPAGATION IN INFINITE MEDIA BY NORMAL COORDINATES WITH AN APPLICATION TO DIFFRACTION. M.A.Biot and I.Tolstoy.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 381-91 (March, 1957).

In the theories of acoustical and electromagnetic vibrations of enclosures, as well as in field theory and electrodynamics, one quite commonly uses normal modes as generalized coordinates in Hilbert space. Here the method is extended to unlimited or partially limited mechanical media, essentially by first solving the problem for an enclosure and going to a limit while expanding all or some of the boundaries to infinity. This leads to a very useful technique, of somewhat more generality than analogous procedures used in field theory. Thus it is applicable to all non-dissipative mechanical continua, for any boundary conditions, irrespective of the order or number of differential operators describing the continua and regardless of whether the coordinate systems are separable or not. A general orthonormality condition valid in all such cases together with the necessary rules for dealing with divergent normalizing coefficients are easily obtained by limiting procedures. An equally general formulation for arbitrary sources is obtained from the principle of virtual work. The method is illustrated by simple examples, for the case of a point source representing the instantaneous injection of air unit volume, i.e., an idealized, infinitely rapid, explosion. It is shown that in the problem of diffraction by a rigid wedge or corner one is led very quickly to an explicit solution in closed form, involving elementary functions only. Some physical implications of this solution are mentioned briefly. The advantages of the normal coordinates

method are discussed when thus used in propagation or diffraction problems in unlimited or partially limited mechanical continua. Obvious advantages are its generality, its flexibility in dealing with arbitrary sources, and the fact that it leads directly to the progressive transient solution. A.

534.213 : 534.27

7678. PROPAGATION OF ELASTIC WAVES IN SPECIAL DIRECTIONS IN CRYSTALS. K.S.Aleksandrov.
Kristallografiya, Vol. 1, No. 6, 718-28 (1956). In Russian.

The special directions of wave propagation (Abstr. 5947/1955) are found for an orthorhombic material and simplified to apply to tetragonal, hexagonal and cubic materials. The results are illustrated by stereograms. The analogy between the propagation of ultrasonic waves and of light in crystals is discussed with special reference to polarization and internal conical refraction (Abstr. 800-1, 2525/1955, 7211/1956). The orientation of a quartz quarter-wave plate is worked out and its application suggested for the production of circularly polarized vibrations in isotropic media. R.F.S.Hearmon

534.22 : 534.23

7679. TUBE CORRECTIONS IN THE STUDY OF SOUND ABSORPTION. F.D.Shields and R.T.Lagemann.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 470-5 (April, 1957).

The absorption and velocity of sound in argon, nitrogen, and carbon dioxide have been investigated over a range of frequency, pressure, and temperature conditions. Use was made of a movable sound source and a stationary microphone, both employing the principle of the ribbon microphone, located inside glass tubing 1.73 cm diameter. It was found that Kirchhoff's equations correctly predicted the absorption and velocity as the temperature was varied from 0 to 200° C in the case of argon and from 0 to 150° C for N_2. Not only did the tube absorption vary as a function of $(f/p)^{1/2}$, but the factor incorporating the physical properties also appears to be valid. Certain earlier experiments have not agreed with the Kirchhoff predictions of the magnitude of the factor which depends on the physical properties, and the success in checking the theory is attributed to the use of improved data for the properties and to the use of precision bore tubing in the apparatus. A.

534.22 : 532.7

7680. NOTE ON FINITE AMPLITUDE WAVES IN LIQUIDS. R.T.Beyer and V.Narasimhan.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 532 (April, 1957).

Published work on ultrasonic attenuation of these waves in water, when plotted in the form of α/f^2 as a function of p/f, approximately fits a single smooth curve (α = amplitude absorption coefficient, f = frequency, p = acoustic pressure). Relaxation processes in aqueous solutions of acetic acid and manganous sulphate presumably preclude similar graphical treatment. H.D.Parbrook

534.22

7681. PRESSURE DEPENDENCE OF SOUND VELOCITY IN ORGANIC LIQUIDS. Y.Wada.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1203 (Nov., 1956).

Rao has shown that $Vu^{1/3}$ is almost independent of temperature for a number of organic liquids, V = specific volume and u = sound velocity. This is thought to indicate the dependence of sound velocity on intermolecular free volume and not upon temperature as such. It is suggested in the present paper that $Vu^{1/3}$ should, on the above reasoning, be independent of pressure also. This is shown by experiment to be the case for a few liquids and a relation is put forward which on the results of the experiments show that $(\partial u/\partial T)_V$ and $(\partial u/\partial P)_V$ are both zero. It is concluded that u should depend only on V. T.C.Toye

534.22 : 532.77

7682. MOLECULAR SOUND VELOCITY OF AQUEOUS SUGAR SOLUTIONS. O.Nomoto and T.Kishimoto.
J. Phys. Soc. Japan, Vol. 12, No. 3, 311 (March, 1957).

This has been measured with an ultrasonic interferometer at 1.43 Mc/s and between 0° and 30° C for each of seven sugars and is shown to be a linear function of concentration (0 to 20% weight). The extrapolated molecular velocity at 100% molar solution agrees approximately with values calculated by Rao's additive rule (J. chem. Phys., Vol. 9, 682, 1940). H.D.Parbrook

534.23 : 534.24

7683. REFLECTION, TRANSMISSION, AND AMPLIFICATION OF SOUND BY A MOVING MEDIUM. H.S.Ribner.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 435-41 (April, 1957).

The reflection and transmission process is analysed for plane sound waves originating in air at rest and impinging obliquely on a plane interface with a moving stream. Use of a moving reference frame provides transformation to an equivalent aerodynamic problem of flows past a wavy wall — the rippled interface. The angles of incidence, reflection, and refraction are identified with the Mach angles. The angular relations and the amplitude relations (coefficients of reflection and transmission) are evaluated in closed form. In a graph three zones can be distinguished in the plane of angle of incidence v. Mach number of the moving medium: ordinary reflection and transmission, total reflection, and amplified reflection and transmission. Included are three loci of infinite reflection: i.e., self-excited waves. The energy balance is examined, and the source of amplification is concluded to be the energy of the moving stream. In appendices the results are generalized (1) for the case of two moving media and (2) for differing density and speed of sound in the two media. A.

534.23

7684. KIRCHHOFF–HELMHOLTZ ABSORPTION IN WIDE AND IN CAPILLARY TUBES AT AUDIBLE FREQUENCIES. P.Mariens.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 442-5 (April, 1957).

The acoustic amplitude attenuation constant has been measured in air for pressures from 2.3 to 0.18 atm in a cylindrical tube of 5.16 cm diameter and in cylindrical capillary tubes of 0.10 and 0.15 cm diameter. In the first series of measurements the amplitude of stationary waves in the wide tube is measured as a function of the distance from the end, and the attenuation constant calculated. In the second series of measurements the measuring tube is closed by a sample of capillary tubes; the absorption coefficient and the phase difference at the input of the samples are measured and from that the attenuation in the capillary tubes is calculated. In both cases it is found that the theoretical values of Kirchhoff–Helmholtz are about 13% lower than the mean experimental ones. A.

534.23

7685. MEASUREMENT OF THE ATTENUATION OF LOW-FREQUENCY UNDERWATER SOUND. M.J.Sheehy and R.Halley.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 464-9 (April, 1957).

Underwater sound signals from the deep atomic explosion of Operation Wigwam in May, 1955, were recorded on bottom-mounted hydrophones at Point Sur and Point Arena, California, and Kaneohe Bay, Oahu. Reflected signals were recorded for two hours at Kaneohe and nearly four hours at Point Sur, and many reflectors were tentatively identified. Values for the attenuation of 20-200 c/s sound in the sea were obtained from an analysis of the change in spectra of the reflected signals with travel distance. These values, plus earlier work at higher frequencies, indicate that the attenuation in dB per kiloyard (kyd) over the frequency range 20 c/s to 60 kc/s is equal to $0.033f^{3/2}$, f being in kc/s. A.

534.23

7686. REAL AND APPARENT ABSORPTION COEFFICIENT OF ULTRASONIC WAVES IN LIQUIDS. A.K.Dutta and K.Samal.
Nature (London), Vol. 179, 95-6 (Jan. 12, 1957).

Measurements have been made using thermostatic trap vessels with thin mica windows immersed in toluene through which the ultrasound is transmitted. The liquid under investigation is placed in the trap vessel and its temperature rise noted. Comparison with the amount of electrical energy necessary to produce the same temperature rise is then made. The results indicate that the absorption coefficient of the outer liquid surrounding the trap varies with the type of the liquid in the trap and possibly with the size of the trap. The absorption coefficient of the liquid in the trap vessel varies both with the pair of sizes of the trap and outer vessels used and possibly also with their position. An attempt at explanation is based on the development of turbulence. T.C.Toye

534.232 : 537.228.1

7687. AN INVESTIGATION OF SOME BARIUM TITANATE COMPOSITIONS FOR TRANSDUCER APPLICATIONS. D.Schofield and R.F.Brown.
Canad. J. Phys., Vol. 35, No. 5, 594-607 (May, 1957).

The most important factor limiting the use of barium titanate in high power electroacoustic transducer applications is the large dielectric loss in high exciting fields. It has been shown that the addition of cobalt to 5% calcium, 95% barium titanate compositions produces a large reduction in the loss in high fields without significantly affecting the piezoelectric constants of polarized ceramic. A.

534.232

7688. ON THE USE OF UNICELLULAR RUBBER FOR UNDER-WATER ACOUSTIC DEVICES. H.Sussman.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 145 (Jan., 1957).

Continued exposure of unicellular rubber under water indicates a loss of its pressure-release and sound reflecting properties. Investigation shows that this is due to gas diffusion through the cell walls of the material into the water. Suggestions are made for the preventation of this gas diffusion by coating the cellular rubber with various plastic films which should have good mechanical properties and be insoluble in water. A.B.Wood

534.232

7689. ACOUSTICAL CHARACTERISTICS OF OSCILLATING JET-EDGE SYSTEMS IN WATER.
J.B.Brackenridge and W.L.Nyborg.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 459-63 (April, 1957).

Observations have been made on the sound radiated by a self-excited underwater jet-edge system, in which a flat jet of water impinges on the sharp edge of a wedge or blade. Comparison is made between the sound (edge tones) generated when a rigid wedge is used, and that when a fixed-free vibrating blade is employed. A characteristic kind of "resonance" is found, similar to that reported by others for analogous systems in air. A.

534.232

7690. SIMPLE SOUND SOURCE IN A 50- TO 300-FOOT-PER-SECOND AIR STREAM. D.R.Boldman.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 532-3 (April, 1957).

Details and performance graphs of an 8 in. long whistle to generate sound levels up to 168 dB when placed in a jet engine air stream. H.D.Parbrook

534.232

7691. RESONATORS OF QUARTZ PLATES TWINNED ACCORDING TO THE BRAZIL LAW.
M.I.Yaroslavskiĭ and I.G.Vasin.
Kristallografiya, Vol. 1, No. 5, 603-6 (1956). In Russian.

Theoretical consideration suggests, and practical tests show that by suitable cutting and disposition of electrodes, it is possible to produce usable oscillator plates from Brazilian twinned quartz. R.F.S.Hearmon

534.321.3

7692. EQUAL BEATING CHROMATIC SCALE. A.L.L.Silver.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 476-81 (April, 1957).

An unequal temperament is described in which the fifths and fourths of the tuning chain have the same beat rate. No Wolf intervals are produced and all intervals can be described by ratios of integers. The equal beating chromatic scale is an excellent approximation to equal temperament; moreover it may well represent a closer approximation to Bach's "well-tempered tuning" than does equal temperament. Circulation of a kind is complete and this tends to restore in some degree the feature of key colour. Inasmuch as there is only one beat rate to observe (very nearly one per second) the procedure for tuning keyboard instruments to this temperament is simpler than that nominally required for equal temperament. Tuning notes are appended. A.

534.321.9

7693. SONIC IMAGES. E.E.Suckling and W.R.Maclean.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 146-8 (Jan., 1957).

Little lateral spread of vibrations occurs in a resonant crystal excited over parts of its surface by an ultrasonic field. Using this fact a transducer system has been devised by means of which sonic images can be obtained (see Abstr. 4466/1955; 5738/1956). The crystal is exposed to the field produced by the object, and the crystal surface is scanned by a small shielded capacitor. The location of an oscilloscope spot is made to follow the movement of the scanner and an image of the object thereby displayed on the oscilloscope screen. Images of various objects obtained in this way are reproduced. R.F.S.Hearmon

534.321.9 : 578.088.5

7694. ULTRASONIC RECORDING OF THE BONES IN A HUMAN ARM. W.N.Beck.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 865 (July, 1957).

534.39

7695. DETECTION OF ULTRASOUND WITH PHOSPHORESCENT MATERIALS. L.A.Petermann and P.B.Oncley.
I.R.E. Trans Ultrasonics Engng, No. PGUE-4, 42-52 (Aug., 1956).

Thermosensitive phosphors of the type CaS—SrS, doubly activated, are found very suitable for the detection of ultrasound around room temperature in the megacycle range; an ultrasonic beam intensity pattern can be converted into a light and dark picture on a phosphorescent screen. A photographic recording of this picture shows a great power of resolution (a few tenths of a millimetre) and a useful sensitivity down to 0.1 to 0.05 watt/cm^2 at 3 Mc/s. A brief theory of the effect is presented with a discussion of the advantages and disadvantages of this method. A

534.39

7696. ULTRASONOGRAPHY BY A BLEACH-OUT METHOD.
T.Schilb, C.Bennett and C.E.Adams.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 145-6 (Jan., 1957).

The production of a recorded visible image by means of ultrasound has been termed "ultrasonography" (Abstr. 4179/1951, 3389/1952). The author now describes a simple method which uses as its basic materials a dye, a bleach and a gelatine-coated glass plate. The plate is soaked in the dye and then, in a medium consisting of a weak aqueous solution of the bleach, is exposed to the ultrasonic field being investigated. The action of the bleach on the dyed gelatine occurs at a rate depending on the intensity of the ultrasound. Illustrations are shown of the beam emanating from a 1 Mc/s quartz crystal with various apertures and beam shapes. A.B.Woo

534.61

7697. ON THE MEASUREMENT OF THE INTENSITY OF ULTRA SONIC WAVES IN LIQUID BY RADIATION PRESSURE METHOD.
T.C.Bhadra.
Trans Bose Res. Inst. Calcutta, Vol. 19, 107-16 (1953-55).

Intensity distributions of progressive ultrasonic waves in liquid media were obtained in absolute values and independent of frequency with a spherical radiometer. The method was extended to measure the energy density with spheres of different radii and also to measure the total pressure (acoustic as well as streaming) on a sphere at different distances from the source. In the first par of the experiment, an attempt was made to measure the energy den ity by calorimetric substitution method for a comparative study.

534.61

7698. RADIATION LOAD ON ARRAYS OF SMALL PISTONS.
W.J.Toulis.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 346-8 (March, 1957).

The radiation load on a piston in an array is examined, preliminarily, through the correspondence of a piston in an infinite long tube and in a conical horn to arrays on an infinite plane surfac and on a rigid sphere, respectively. The evaluation of the velocity potential for the two arrays suggests that the average radiation loa on an array consists of two terms. The principal term arises from a uniform distribution of the total source strength over both active and inactive areas of the array. The secondary term corresponds the free space load for one of the pistons but reduced in magnitude by a factor proportional to the average separation between adjacent pistons.

534.

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612

534.

7699. VISUAL INDICATION OF SPEECH AS AN AID TO HEARING IT IN NOISE AND BABBLE. L.R.Decker and J.M.Pick
J. Acoust. Soc. Amer., Vol. 29, No. 1, 150-1 (Jan., 1957).

Intelligibility tests were conducted over earphones at low signal-to-noise ratios. The signal consisted of two male talkers reading phonetically balanced words, and the noise was: (A) babbl obtained from 4, 8, 16, and 32 simultaneous voices, and (B) rando noise. Six listeners responded alternately with and without the visual aid of a level meter of the volume unit (vu) type. Experimental results show that the visual indication does not improve intelligibility, even though the meter was energized by the signal only. D.J.Ha

534.7

7700. ON THE FUNDAMENTAL QUALITIES OF SPEECH IN COMMUNICATION. Y.Ochiai and T.Fukumura.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 392-3 (March, 1957).

By using band eliminating and rotational synchronous distorti two different qualities were found to characterize speech. The qu ity distribution in the frequency domain for the Japanese vowels w obtained, as was the quality distribution for a number of voices, which were each characterized by a vocal formant. A distinction was made between vocal and phonemic quality. D.J.Ha

534.784 : 534.322.2

7701. ESTIMATES OF THE MAXIMUM PRECISION NECESSARY IN QUANTIZING CERTAIN "DIMENSIONS" OF VOWEL SOUNDS. J.L.Flanagan.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 533-4 (April, 1957).

Experiments have been performed to measure the just noticeable differences in some frequency and amplitude parameters which describe vowels, since perceptual discrimination determines how accurately these parameters need be specified. The fundamental vocal frequency and that of the first and second formants, the amplitude of the second formant, and the overall amplitude of synthetic vowels was controlled. The average ranges occupied by these parameters and the frequency and amplitude of the third formant are known, and so the number of divisions in these parameters may be specified in conjunction with the discrimination data. Hence also the quantity of information may be obtained. Assuming a sampling rate of 20 per second, the total information rate is 420 bits/sec, 340 bits/sec for the frequency parameters, and 80 for the amplitude parameters. D.J.Hall

534.79 : 534.61

7702. MEASUREMENT OF LOUDNESS: AN ADDENDUM. B.Semeonoff.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 311-13 (Feb., 1957).

Some early but hitherto unpublished work on the measurement of loudness is reported, primarily for its relevance to the recent survey of this subject by S.S.Stevens (Abstr. 9518/1955; Science, Vol. 121, 113, Jan. 28, 1955 and Journal of Experimental Psychology, Vol. 51, 71, 1956). Experiments using methods of magnitude estimation and of constant stimuli have been carried out with a 512 c/s tone from an electrically-driven tuning fork at levels of approximately 60 to 100 dB. Fairly marked differences were found between estimates of half and double loudness made by 3 subjects, each of whom showed individual consistency. On the whole, greater decibel change was needed for double than for half-loudness e.g. 11 dB compared with 6 dB. Experiments on bisection of loudness intervals were also carried out, the results showing discrepancies from predicted values. A.B.Wood

534.835

7703. A CRITERION FOR NOISE CONTROL. K.D.Kryter.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 311 (Feb., 1957).

Various criteria for defining acceptable levels of noise in office buildings are briefly discussed, including loudness, masking and speech interference level. A tentative conclusion is reached that a loudness level of about 60 phons represents a reasonable criterion. G.F.Hodsman

OPTICS. RADIATION. SPECTRA 535

535.14

7704. CORRELATION BETWEEN EVENTS IN PHOTON DETECTORS. R.M.Sillitto.
Nature (London), Vol. 179, 1127-8 (June 1, 1957).

It is shown that an equation derived by Purcell (Abstr. 4108/1957) can be obtained from a very simple model which shows clearly the nature of the physical processes involved. The possibility of analogous interference between electrons is discussed. P.M.Davidson

535.14

7705. REMARKS CONCERNING EXPERIMENTS FOR DEMONSTRATING THE QUANTUM NATURE OF VISIBLE LIGHT. R.Schneiderreit.
Naturwissenschaften, Vol. 44, No. 3, 58 (1957). In German.

535.14 : 537.533.9

QUANTUM THEORY OF REFRACTIVE INDEX. See Abstr. 7163

535.247.4

7706. A PHOTOELECTRIC TELEPHOTOMETER OF HIGH SENSITIVITY AND HIGH ANGULAR SELECTIVITY. F.F.Crandell and K.Freund.
Illum. Engng, Vol. 52, No. 6, 319-22 (June, 1957).

A diaphragm is placed in the image plane of a reflecting telescope so that the light from a very small area of the image reaches a photomultiplier cell. A similar cell is illuminated by light from a local source and the two outputs are balanced to measure the light passing through the diaphragm. By calibration this gives the luminance of the corresponding area in the field of view of the telescope. The range of angular diameters is from 34 to 0.34 min of arc and the corresponding minimum measurable luminances are 10^{-5} and 0.1 foot-lambert. J.W.T.Walsh

535.29

7707. MEASUREMENT OF THE SPECTRAL REFLECTING POWER OF SOLID BODIES IN THE INFRARED. C.Tingwaldt.
Z. InstrumKde, Vol. 65, No. 1, 7-10 (Jan., 1957). In German.

A black body held at the sulphur point contains a water cooled probe, coated with the metal surface under investigation. The reflection coefficient can be measured over the range 2-10 μ. Results are given for a number of common metals. R.W.Fish

535.3

7708. FIBER OPTICS. III. FIELD FLATTENERS. N.S.Kapany and R.E.Hopkins.
J. Opt. Soc. Amer., Vol. 47, No. 7, 594-8 (July, 1957).

For Pt I-II, see Abstr. 5950-1 (1957). A method of field flattening using a bundle of transparent fibres is studied in some detail. Different optical arrangements of field flatteners are proposed and their relative merits are investigated. An improved type of field flattener which also acts as two Fresnel lenses has been developed and the term "Fresnel lens type field flattener" is proposed to denote it. A gain in image quality and weight of a flight periscope system seems possible by the use of such a field flattener. The methods of alignment and fabrication of these field flatteners are described. Working models using 200 μ diameter glass fibres have been constructed which demonstrate the expected gain. A.

535.316

7709. SKEW ASTIGMATISM AT TORIC SURFACES, WITH SPECIAL REFERENCE TO SPECTACLE LENSES. A.E.Murray.
J. Opt. Soc. Amer., Vol. 47, No. 7, 599-602 (July, 1957).

Sturm's relations governing the behaviour of thin pencils of rays is applied to skew refraction at toric surfaces. The general relations are simplified and an estimate of the resulting error is derived. Exact results are presented for the 45° intermediate plane trace at 30° vista angle in a −4.00 diopter sphere combined with a 4.00 diopter convex cylinder toric lens. An alternate skew toric trace is described. A.

535.317.1 : 771.531

7710. ON THE LIGHT DISTRIBUTION IN THE PHOTOGRAPHIC IMAGE. K.Sayanagi.
J. Opt. Soc. Amer., Vol. 47, No. 6, 566-7 (June, 1957).

Instead of a one-dimensional intensity function for a point light source, previously used by Ingelstam to determine the response function of the emulsion (Abstr. 7253/1956), a two-dimensional function is proposed. From this the derived curve of response v. spatial frequency (in lines/mm) agrees slightly better with the experimental data than does the earlier theoretical curve. The profile of intensity distribution in a line image on the alternative assumptions also suggests that the new proposal may show better agreement with experiment. S.T.Henderson

535.317.1 : 771.531

7711. ON THE CHOICE BETWEEN DIFFERENT FUNCTIONS OF LIGHT DIFFUSION IN PHOTOGRAPHIC EMULSIONS. E.Ingelstam and E.Djurle.
J. Opt. Soc. Amer., Vol. 47, No. 6, 567 (June, 1957).

Sayanagi's method is approved (see preceding abstract), but it is considered that more experimental evidence is required before a decision is made as to the best assumptions, especially since intensity curves may be more complex than was thought hitherto. S.T.Henderson

535.317.1

7712. ANALYSIS OF SPOT DIAGRAMS. M.Herzberger.
J. Opt. Soc. Amer., Vol. 47, No. 7, 584-94 (July, 1957).

A method has been described previously whereby, as a result of tracing relatively few rays through an optical system, the intersection points of a large number of rays from an object point with any assumed image plane can be found by means of an interpolation formula. When these latter rays are distributed equally over the exit pupil, the resulting spot diagram indicates the distribution of illuminance in the image of the point. The interpolation formula is of the fifth degree. In the present paper, the coefficients of this formula are grouped according to increasing powers of the aperture, thus giving a new type of image theory for large aperture and field. This new analysis of the image errors leads to simple geometrical patterns that enable the designer to ascertain the effect of changes in the constructional data on the complex spot diagrams. The analysis is applied to an actual lens, and an example of the way it is used to improve the lens is given. A.

535.317.5

7713. THIRD-ORDER ABERRATION THEORY FOR VARIFOCAL SYSTEMS. L.Bergstein and L.Motz.
J. Opt. Soc. Amer., Vol. 47, No. 7, 579-83 (July, 1957).

Formulae are developed for calculating the Seidel partial coefficients for a lens system as functions of changes in the parameters of the system (bendings) to all orders of accuracy within the third-order theory. These formulae are used to obtain a set of second degree simultaneous equations for the correction of the Seidel aberrations for a four component varifocal system. A.

535.317.6

7714. AUTOMATIC RAY TRACING. M.Herzberger.
J. Opt. Soc. Amer., Vol. 47, No. 8, 736-9 (Aug., 1957).

Ray-tracing formulae are developed for refraction or reflection at a plane surface, a spherical surface, or an aspheric surface with rotational symmetry. The formulae have similar forms for all types of surface and for both meridional and skew rays, and they are especially adapted for rapid automatic computers. Certain quantities enter the formulae implicitly, and an approximation formula is developed for computing these quantities with adequate precision on the first repetition. A.

535.317.6

7715. COMPENSATION OF ABERRATIONS CAUSED BY OBLIQUE PLANE-PARALLEL PLATES. H.de Lang.
Philips Res. Rep., Vol. 12, No. 3, 181-9 (June, 1957).

Methods are given for the correction of aberrations (astigmatism and coma) introduced by an oblique plane-parallel plate in a convergent beam. It is shown that astigmatism can be eliminated, either by giving the plate a slight amount of prismaticy or by giving the rear surface of the plate a slight amount of spherical or cylindrical curvature. In practical cases the first method is preferable as it avoids cylindrical surfaces and also nearly eliminates coma. Off-axis correction of astigmatism imposes the extra condition that the derivative of the astigmatism in the meridional section be zero. It is shown that in general this off-axis correction can be achieved by a suitable combination of prismaticy and curvature. A.

535.323

7716. INDEX OF REFRACTION OF ROCHELLE SALT NEAR THE PHASE-TRANSITION POINT.
K.N.Baranskiĭ, L.A.Gribov and V.P.Prikhod'ko.
Kristallografiya, Vol. 1, No. 3, 368-9 (1956). In Russian.

The indices of refraction at λ = 5460 A of two Rochelle salt prisms were measured as a function of temperature. The dependence on temperature is linear, and there is no departure from linearity at the upper Curie point. R.F.S.Hearmon

535.324.2

7717. THE IMPORTANCE OF THE DIAPHRAGM IN THE SCALE METHOD OF LAMM. H.Jakob.
Naturwissenschaften, Vol. 44, No. 9, 277-8 (1957). In German.

The Lamm method of determining small index differences in solutions depends for its accuracy and definition upon the correct choice of diaphragm. An improved optical arrangement is described. R.W.Fish

535.33 : 536.46

7718. THE SPECTROSCOPY OF FLAMES. A.G.Gaydon.
London: Chapman and Hall (1957) x + 279 pp.

Experimental techniques for the study of the emission and absorption spectra of flames are described. These include the study of flat flames, low-pressure flames, low-temperature flames, cool flames, atomic flames, flash photolysis, shock tubes and isotopic tracer work. Spectra of various flames, including those supported by air, oxygen, oxides of nitrogen and halogens, are described in detail, with tables of wavelengths and plates. Infrared spectra are included. Interpretation of results is discussed in relation to chemical processes of combustion, excitation processes and temperature measurements. Chapters deal with applications to engines and to flame photometry for spectrochemical analysis.

535.33.03

7719. HYDROGEN LAMP OF GOOD INTENSITY AND RELIABILITY FOR THE VACUUM ULTRAVIOLET.
P.L.Hartman and J.R.Nelson.
J. Opt. Soc. Amer., Vol. 47, No. 7, 646-8 (July, 1957).

A reliable, easily constructed, hydrogen discharge lamp has been developed and used extensively as a light source for optical experiments in the vacuum ultraviolet (between 900 and 1800 A). The lamp is a rather intense source of radiation consisting of the many-lined molecular spectrum of hydrogen. A.

535.33.

7720. A "FREE SPACE" ABSORPTION CELL FOR MICROWAV SPECTROSCOPY. C.C.Costain.
Canad. J. Phys., Vol. 35, No. 3, 241-7 (March, 1957).

The absorption cell consists simply of a pyrex tube with a po styrene lens and microwave horn at each end to couple to the stan ard microwave components. The lenses also serve as the vacuum windows. The attenuation at 8.5 mm wavelength is 3.4 dB for a 250 cm cell. Since there are no metal surfaces, this type of cell very suitable for the investigation of reactive molecules. It can readily be employed in a high-temperature microwave spectrome for the investigation of corrosive substances with low vapour pres sures, or in a Zeeman modulation spectrometer for the study of free radicals.

535.33.07 : 535.242.

7721. AN AUTOMATIC FILTER SPECTROGRAPH. E.Rohner.
Dissert. E.T.H. Zürich, No. 2621, 79 pp. (1956). In German.

The spectrograph described was designed for rapid, automati execution of many spectral and integral measurements: determin ation of energy distribution of light emitters, measurement of passband of filters, reflection curves of pigments, V(λ) character istic of an emitter, and determination of colour co-ordinates of primary and secondary emitters. The results are displayed on th screen of a cathode-ray-tube. The monochromator uses interfere filters with comparatively high resolution. The theory of inter ference filters and the theoretical basis of the principle of operat of the apparatus are explained, and the errors of measurements a discussed. The construction of the optical and mechanical parts o the spectrograph is described and illustrated by drawings and pho graphs. The filter disk (500 mm) has 360 positions for fixing the filters, but no more than 30 filters can be accommodated. Total range is 380-730 mμ. Type 6217 R.C.A. multiplier is used as a detector. Spectral sensitivity can be varied. Errors caused when spectral lines fall in the passband of the filters are compensated. Method of calibration is presented. Different measurements per formed with the apparatus are described, and results are compar with those obtained by other spectrographs. J.M.Silberste

535.33

7722. ON DEPENDENCE OF RESOLVING POWER ON BACK-GROUND INTENSITY, STAGE OF RESOLUTION AND DETECTIN INSTRUMENT. K.C.Chaturvedi and M.S.Sodha.
Indian J. Phys., Vol. 30, No. 11, 543-52 (Nov., 1956).

Discusses the variation of resolving power of prism, grating reflecting echelon and Fabry—Perot etalon with background inten sity, stage of resolution desired and the detecting instrument, wh natural line width is negligible. The case when instrumental widt is negligible is also discussed.

535.33

7723. SEPARATION OF OVERLAPPING ORDERS OF A CONCA GRATING SPECTROGRAPH IN THE VACUUM ULTRAVIOLET REGION. A.E.Douglas and G.Herzberg.
J. Opt. Soc. Amer., Vol. 47, No. 7, 625-8 (July, 1957).

A method of separating the overlapping orders of a concave grating spectrograph in the vacuum ultraviolet region by means o grazing incidence concave foregrating is described. It is shown t by a suitable choice of the constants of the foregrating it is possi to eliminate the astigmatism of the whole system. Experimental results obtained with such a foregrating are shown.

535.33

7724. EXPERIMENTAL STUDY OF THE SLIT FUNCTION OF AN EBERT SPECTROMETER IN THE VISIBLE AND NEAR-INFRARED. P.C.von Planta.
J. Opt. Soc. Amer., Vol. 47, No. 7, 629-31 (July, 1957).

The slit function of an Ebert spectrometer has been measure with different f numbers at the wavelength of the 0.5461 μ Hg line and the 2.05 μ He line. It is shown that the slit function changes from a single slit diffraction pattern to a Gaussian and finally to triangular function for increasing slit width.

535.33

7725. LINEARIZING INFRARED SPECTRA. F.S.Brackett.
J. Opt. Soc. Amer., Vol. 47, No. 7, 636-8 (July, 1957).

A linear frequency or wavelength scale is obtained for sever choices of prismatic dispersion by substituting commercially ava able cams for the existing tangent screw drive in a spectrometer A practical solution to the related mechanical problems is offere and other problems of linearization discussed.

535.33.07

7726. INTERFEROMETRIC SPECTROMETER FOR THE INFRARED. R.G.Greenler.
J. Opt. Soc. Amer., Vol. 47, No. 7, 642-6 (July, 1957).

An interferometric spectrometer of the Fabry—Perot type has been built for the infrared spectral region and its resolving power has been tested on the 10 μ band of NH_3. The interferometer has two sets of plates. One set of plates is closely spaced to isolate a free spectral range for the other set, which is more widely spaced to achieve the final resolution. Wavelength scanning is achieved by a synchronized mechanical separation of both sets of plates. The interferometer plates are figured rock salt crystal plates coated with evaporated multilayers of tellurium and sodium chloride. A.

535.331 : 539.153.4

7727. EMISSION SPECTRA OF ACTINIUM.
W.F.Meggers, M.Fred and F.S.Tomkins.
J. Res. Nat. Bur. Stand., Vol. 58, No. 6, 297-315 (June, 1957).

Small samples of actinium, produced by transmuting radium, have been investigated spectroscopically by photographing the spectra of light emitted by the samples when excited in a hollow cathode or in arcs and sparks between copper or silver electrodes. The wavelengths were measured, and intensities estimated, for some 500 lines characteristic of actinium in the spectral range 2062.00 to 7886.82 A. A comparison of line characteristics in different sources permitted sorting into five categories; about 140 lines belong to Ac I, more than 300 were ascribed to Ac II, 8 were definitely assigned to Ac III, 5 may belong to Ac IV, and about 80 represent band heads characteristic of AcO, the actinium monoxide molecule. Analyses of the first three spectra of actinium have revealed their most important features, including atomic-energy levels, spectral terms, and electron configurations. The ground state of Ac III is found to be $(7s)^2S_{0\,1/2}$, that of Ac II is $(7s^2)^1S_0$, and that of Ac I is $(6d7s^2)^2D_{1^1/_2}$. Comparisons of the analogous spectra of the chemical homologues (scandium, yttrium, lanthanum, and actinium) show that actinium closely resembles yttrium, except that additional terms of odd parity, first found in lanthanum spectra and attributed to the 4f-electron, are also found in actinium spectra, where they provide evidence of the presence of the 5f-electron. The binding force on the 4f-electron in La II is much stronger than on 5f in Ac II. The principal ionization potential of Ac^+ ions is about 12.0 electron volts. A.

535.333

7728. BANDS ASSIGNED TO ZrF. P.K.Carroll and P.J.Daly.
Proc. Phys. Soc. A, Vol. 70, Pt 7, 549-50 (July, 1957).

The bands observed by Afaf (Abstr. 5691/1950) using a low-voltage copper arc as a source, the anode of which was charged with ZrF_4, were shown to be due to CuF molecules by experiments with different sources and fluorides. R.Stratton

535.333

7729. EXCITATION OF NITROGEN BY PROTONS OF A FEW keV ENERGY. N.P.Carleton.
Phys. Rev., Vol. 107, No. 1, 110-13 (July 1, 1957).

This work was undertaken to aid in interpreting auroral spectra. The dependence of the intensity of the various spectral features on the proton current and gas pressure gives evidence about the excitation mechanisms. The conclusions are that the first negative and Meinel systems of N_2^+ are excited through charge exchange, that the first positive system of N_2 is excited, not by proton impact, but by the impact of fast neutral atoms, that allowed NI lines are excited by a single process involving dissociation and excitation, and that the Balmer lines result from charge capture directly into an excited state. As compared with excitation by electron impact, vibration is enhanced in the upper level of the first positive system, but rotational temperatures derived from the first negative system of N_2 agree with the gas temperature. A.

535.333 : 541.126

7730. LUMINOUS REACTION BETWEEN CARBON MONOXIDE AND ATOMIC NITROGEN. H.P.Broida and D.F.Heath.
J. chem. Phys., Vol. 26, No. 5, 1352 (May, 1957).

The spectra observed from the reaction were predominantly the red and violet systems of CN. Comparison is made with the spectra obtained from atomic nitrogen and acetylene under the same experimental conditions. An outline is given of the experimental procedure. W.Good

535.337.08

7731. MEASUREMENT BY PHOTOELECTRIC FRINGE SCANNING OF THE PRESSURE SHIFT OF Hg 198 EMISSION LINES. K.M.Baird and D.S.Smith.
Canad. J. Phys., Vol. 35, No. 4, 455-61 (April, 1957).

Photoelectric fringe scanning apparatus has been developed for the measurement of very small wavelength changes (of the order of 5×10^{-5} A). This paper describes its application to a direct measurement of the shift of some of the visible lines of Hg^{198} caused by the presence of the various rare gases used as a carrier. The values found for the shift in wave-number are all of the order of 2×10^{-4} cm^{-1} per mm (Torr) pressure and to the red, except for He, for which it is somewhat less than 1×10^{-4} cm^{-1} per mm and to the blue. A.

535.338.334

7732. BROADENING AND SHIFT OF SPECTRAL LINES DUE TO THE PRESENCE OF FOREIGN GASES. S.Ch'en and M.Takeo.
Rev. mod. Phys., Vol. 29, No. 1, 20-73 (Jan., 1957).

This comprehensive review is intended as a sequel to that of Margenau and Watson (1936-37) and deals with pressure-induced broadening and shifts of atomic and molecular lines in the ultraviolet, visible, infrared and microwave regions by neutral particles. The effects of electron and ion collisions and high temperature broadening are not treated. The following topics are discussed: (A) Causes producing broadening and shift of spectral lines; (B) Impact theory; (C) Statistical theory; (D) Theory at general pressures; (E) Fine structure pressure broadening of atomic lines. Experimental Observations: (A) Pressure shift and broadening of atomic lines; (B) The fine structure and pressure effects; (C) Narrow diffuse bands of various metals produced by close encounters with foreign particles; (D) Pressure broadening of molecular bands in the infrared region; (E) Pressure broadening of lines in the microwave region.

R.W.Nicholls

535.338.334

7733. LINE SHAPE. R.G.Breene,Jr.
Rev. mod. Phys., Vol. 29, No. 1, 94-143 (Jan., 1957).

This review discusses the development of the theory of line shape and broadening since Michelson's original contributions to the subject in 1895. (See also preceding abstract). The topics reviewed are: (i) Early line broadening theory; (ii) Stark broadening; (iii) Statistical broadening; (iv) Interruption broadening; (v) Resonance broadening; (vi) Molecular broadening.

R.W.Nicholls

535.34

7734. INTENSITIES OF ROTATION LINES IN ABSORPTION BANDS. H.Hanson, H.H.Nielsen, W.H.Shaffer and J.Waggoner.
J. chem. Phys., Vol. 27, No. 1, 40-3 (July, 1957).

An alternate method of computing the influence of vibration—rotation interaction on the intensities of lines in the band spectra of molecules from that discussed by Herman and Wallis and by Herman and Rubin is presented. The method consists of transforming the Hamiltonian of the molecule by a contact transformation so that the wave-functions remain those for a harmonic oscillator-rotator. The electric moment must then also be transformed by the same contact transformation before the matrix elements of the electric moment are computed. The method is applied to a diatomic molecule and gives the same results as those stated by Herman and Wallis. A.

535.343

7735. THE NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF 1,2,4-TRIFLUOROBENZENE VAPOR. K.Narahari Rao and H.Sponer.
Canad. J. Phys., Vol. 35, No. 3, 332-40 (March, 1957).

The vapour spectrum of 1,2,4-trifluorobenzene at 2810-2460 A was obtained with a 3 m grating in an Eagle mounting. The band at 37 126 cm^{-1} was taken as the 0—0 band of the A'—A' transition. The excited state vibrations 698, 746, 1274, and 1369 cm^{-1}, which are totally symmetric, appear in progressions and combinations. Their correlation to vibrational modes is discussed. The 1274 belongs to a C—F bond stretching mode. Possibilities are discussed to explain the structure of the first group upon which the spectrum is built. A.

535.343

7736. ULTRAVIOLET ABSORPTION SPECTRA OF O-METHOXY-PHENOL AND 2, 4, 6-TRICHLOROPHENOL IN DIFFERENT STATES. S.K.Sen.
Indian J. Phys., Vol. 30, No. 11, 553-60 (Nov., 1956).

Absorption spectra have been studied and the results compared with those of chlorophenols reported by previous authors. Raman spectra of the liquids have also been investigated. Major change is observed to occur in the spectrum of o-methoxyphenol on liquefaction of the vapour with a shift of the 0, 0 band by 550 cm^{-1} towards longer wavelengths. In the spectrum due to the solid state at low temperatures, the 0, 0 band is observed to be displaced towards shorter wavelengths by 100 cm^{-1} from its position in the spectrum due to the liquid and the bands become sharper. The 0, 0 band of 2, 4,

6-trichlorophenol is also found to shift by 495 cm^{-1} towards longer wavelengths on liquefaction of the vapour. With solidification and cooling down to −180°C, the 0, 0 band shifts by 390 cm^{-1} towards shorter wavelengths and the bands are found to be sharper. By comparing the results with those for chlorophenols it is concluded that the perturbing field resulting in the changes in the electronic spectra depends on the presence or absence of permanent electric moment. So, it has been suggested that in the case of substituted benzenes, Davydov splitting alone cannot account for the observed changes. A.

535.343

7737. ULTRAVIOLET ABSORPTION SPECTRA OF SOLUTIONS OF BROMOTOLUENES IN ISOBUTYL ALCOHOL AT DIFFERENT TEMPERATURES. S.B.Roy.
Indian J. Phys., Vol. 30, No. 12, 590-8 (Dec., 1956).

Ultraviolet absorption spectra of 0.2% and 40% solutions of ortho-, meta- and para-bromotoluene in isobutyl alcohol in the liquid state and in the solid state at −180°C have been investigated and the results have been compared with those obtained in the case of pure substances in different states, as reported by previous workers. The splitting of the absorption bands in the case of ortho- and meta-bromotoluene in the solid state observed by previous workers is found to be absent in the case of 0.2% frozen solution, but the spectrum due to 40% frozen solution in each case shows a broad band system which seems to be composed of two systems of bands, one due to 0.2% frozen solution and another due to the pure substance in the solid state. The absorption spectrum of 0.2% solution of para-bromotoluene resembles that due to the vapour and that due to 40% solution resembles that due to the pure liquid. The absorption spectra of frozen solutions of the para compound do not show any splitting as in the case of pure crystals. It is concluded that splitting of the absorption band is not due to the lattice field but may be due to the presence of strongly assymetric groups of molecules in the crystals. A.

535.343

7738. ULTRAVIOLET ABSORPTION SPECTRA OF ISOMERIC PICOLINES IN THE LIQUID AND SOLID STATES. S.B.Banerjee.
Indian J. Phys., Vol. 31, No. 1, 11-19 (Jan., 1957).

The ultraviolet absorption spectra of α-, β- and γ-picoline have been investigated in the liquid state and in the solid state at −180°C. The results have been compared with those observed for the substances in the vapour state by previous workers. All the three compounds exhibit two systems of bands in the vapour state, the first system being attributed to $n \rightarrow \pi^*$ transition (Transition I) and the other system to $\pi \rightarrow \pi^*$ transition (Transition II). It is observed, however, that in the liquid and solid states these substances yield only one system of bands corresponding to Transition II. The ν_0-band in each case is found to undergo large shift towards longer wavelengths with liquefaction of the vapour. With solidification and lowering of temperature to −180°C the bands get a little sharper and the ν_0-bands are further displaced slightly towards longer wavelengths. The results have been interpreted on the assumption that in the condensed phases the molecules of picolines form associated groups probably through the nitrogen non-bonding electron and a hydrogen atom of neighbouring molecules. A.

535.343 : 541.126

7739. ULTRAVIOLET ABSORPTION SPECTRA AND THE CHEMICAL MECHANISM OF CS_2—O_2 EXPLOSIONS.
A.L.Myerson, F.R.Taylor and P.L.Hanst.
J. chem. Phys., Vol. 26, No. 5, 1309-20 (May, 1957).

Ultraviolet absorption spectra have been obtained at various times during and after homogeneous explosions of carbon disulphide—oxygen mixtures thermally initiated at temperatures of 190 to 300°C. This has been accomplished by triggering a flash source of continuum by means of the early chemiluminescence of the explosion. These photographically recorded spectra show the presence, and the absorption intensity as a function of time, of CS, SO, SO_2, S_2O_2, S_2, CS_2 and a species which absorbs in a continuum, to which has been assigned the structure of a sulphur superoxide, SOO. Numerous conclusions have been reached from these data concerning the elementary chemical reactions that are involved in these experiments. A direct bimolecular reaction is postulated for the initiation process which produces the superoxide, and eventually free radicals. In the very early stages of the explosion, propagation proceeds via a slowly branching primary chain which involves an attack on the reactants by sulphur and oxygen atoms. As the branching reaction proceeds and the temperature increases, the mechanism undergoes a number of changes including an increase in the importance of a nonfree radical, bimolecular process. The explosion is especially interesting in that one of the final products, sulphur oxide, does not appear in more th minor concentrations, almost characteristic of an intermediate, unt the explosion is over. This is explained in terms of the reactions postulated. A

535.34

7740. ULTRAVIOLET ABSORPTION OF PYRAZINE VAPOR DU TO n—π TRANSITION.
M.Ito, R.Shimada, T.Kuraishi and W.Mizushima.
J. chem. Phys., Vol. 26, No. 6, 1508-15 (June, 1957).

The near ultraviolet absorption spectrum of pyrazine vapour was photographed and measured. A tentative vibrational analysis was made for some of the bands in the longest wavelength discrete band system (3200 A system), due to the n—π transition. The spectral band feature shows that the 3200 A system is a superposition o two absorption systems which belong to different electronic transiti ions. It appears that this conclusion is also supported by simple theoretical considerations. A

535.34

7741. OPTICAL SPECTRA OF HYDRATED IONS OF THE TRANSITION METALS O.G.Holmes and D.S.McClure.
J. chem. Phys., Vol. 26, No. 6, 1686-94 (June, 1957).

The absorption spectra of crystalline hydrates of the first transition group ions have been measured with polarized light at room temperature, and with unpolarized light at a series of lower temperatures. Some new data on solution spectra have also been obtained. The values of Dq for these compounds are obtained, and are used to explain irregularities in the heats of hydration of the ions. The temperature dependence of the spectra shows that the transitions are vibration-induced electric-dipole transitions for the most part. The dichroism has been used to resolve some of the bands and to determine the effect of noncubic components of the crystal field. A

535.343 : 538.615 : 548.

7742. ZEEMAN EFFECT AND CRYSTAL FIELD IN HEXAGONA EUROPIUM ETHYL SULPHATE.
K.H.Hellwege, U.Johnsen, H.G.Kahle and G.Schaack.
Z. Phys., Vol. 148, No. 1, 112-127 (1957). In German.

The absorption spectrum was examined under a dispersion of 0.84 A/mm in the visible region at room, liquid air and liquid helium temperatures. A magnetic field of 30 000 Oe and polarized light we used. The splitting of the term was linear or quadratic correspond ing to the magnetic field being parallel or perpendicular to the crystal axis and the experimental results were explained as a first orde perturbation of the Eu ions. The g factor of the upper term in the transition ($^7F_0$-$^5D_{1,2,}$) was found to be 1.49 ± 0.01 and its assignmen was confirmed. L.Bove

535.343 : 539.132

7743. INFRARED LINE AND BAND STRENGTHS AND DIPOLE MOMENT FUNCTION IN HCl AND DCl. W.S.Benedict, R.Herman, G.E.Moore and S.Silverman.
J. chem. Phys., Vol. 26, No. 6, 1671-7 (June, 1957).

Strengths of the individual isotopic lines have been measured in the 2—0, 3—0, 2—1 and 3—2 bands of HCl^{35} and HCl^{37} and in the 1—0, 2—0, and 3—0 bands of DCl^{35} and DCl^{37}. The relative line strengths for the 1—0 band of DCl are shown to agree with that expected theoretically including the effect of the interaction of vibration and rotation, but the line strengths in the 2—0 bands agree abou equally well with the rigid rotor and with the theoretical expression including the vibration—rotation interaction. Experimental band strengths and vibrational matrix elements are derived from the measured line strengths for each band. These data are combined with previous results on the HCl 1—0 band to obtain power series expansions for the electric dipole moment function of the hydrogen chloride molecule. It is found that the effective charge is of the same sign as the permanent moment and that the second derivatives of the dipole moment with respect to internuclear distance at r_e is probably of opposite sign. In general, for the same number of term in the dipole moment expansion it is found that Morse vibrational wave-functions give considerably better agreement between observ and calculated matrix elements than do anharmonic oscillator funct ions retaining terms in the potential energy through the fourth pow in the internuclear separation. A

535.34

7744. VIBRATION-ROTATION SPECTRA OF SIMPLE DIATOMI OR POLYATOMIC MOLECULES USING A LONG ABSORPTION PATH. XII. THE SPECTRUM OF $C^{12}O^{16}_2$ BETWEEN 3500 AND

8000 cm^{-1} AND THE MOLECULAR CONSTANTS OF THIS MOLECULE. C.P.Courtoy.
Canad. J. Phys., Vol. 35, No. 5, 608-48 (May, 1957). In French.

Numerous absorption bands of the molecule $C^{12}O^{16}{}_2$ have been obtained in the near infrared under high resolution with the help of a multiple path absorption cell. Of these bands, 27 have been analysed, among them three $\Delta-\Delta$ transitions. The usual formula for the vibrational levels has been extended to include cubic terms and the values of the vibrational constants are given. Similarly the rotational constants B_V have been expressed by a formula including quadratic terms and the constants in this formula are given. The values of B_0 and B_e obtained here are respectively 0.390 21 ± 0.000 04 and 0.391 62 cm^{-1}. The l-type doubling constant q_V of the Π states (apart from effects of Fermi resonance) can be represented by $q_V = (63 - 1.5v_3)\,½(v_2+1)$. The perturbation term of the Fermi resonance is given by the expression $(51.31 - 0.15v_1 - 0.41v_2 - 0.78v_3)\,½[(v_2+2)^2 - l^2]^{1/2}v_1{}^{1/2}$, where the quantum number l does not enter the first factor. The introduction of this expression allows one to represent all the vibrational levels as well as the rotational constants of each level and the constant q of the Π states with excellent precision. The value of D_0 is found to be 13.5×10^{-8} cm^{-1}. The effect of the Fermi resonance and of the perturbation between levels (v_1,v_2,l,v_3) and $(v_1,v_2,l\pm2,v_3)$ on the constants D is discussed. The experimental values for these constants agree in a very satisfactory way with those calculated by Amat, Goldsmith and Nielsen as do the constants μ of l-type doubling of the Π states. Finally the effect of Coriolis perturbation between the levels $32^0$0 and $(05^11)^C$ is demonstrated. A.

535.343

7745. STRUCTURE OF THE FUNDAMENTAL INFRARED BAND OF HYDROGEN IN PRESSURE INDUCED ABSORPTION.
H.P.Gush, A.Nanassy and H.L.Welsh.
Canad. J. Phys., Vol. 35, No. 7, 712-19 (June, 1957).

The doublet structures observed by Coulon, Galatry, Robin and Vodar (1955) in the Qp and S(1) components of the pressure-induced fundamental infrared band of hydrogen have been reinvestigated under various conditions of temperature and pressure. It is concluded that the structures can be interpreted in terms of kinetic energy interactions which have already been shown to give rise to the main components, Q_P and Q_R, of the Q branch. A.

535.343 : 539.133

7746. VIBRATIONAL SPECTRUM AND STRUCTURE OF METAL-CYANIDE COMPLEXES IN THE SOLID STATE. I. $KAg(CN)_2$.
L.H.Jones.
J. chem. Phys., Vol. 26, No. 6, 1578-84 (June, 1957).

The infrared spectra of solid $KAg(CN)_2$ and the mono- and di-substituted C^{13} and N^{15} species have been observed. The seven fundamental vibrations of the linear, symmetrical $Ag(CN)_2^-$ ion have been assigned at 2146, 360, 2140, 390, 250, 310, and 107 cm^{-1} for the species containing C^{12} and N^{14}. From the observed frequencies of the normal and isotopic species, force constants were calculated for two possible structures: N–C–Ag–C–N and C–N–Ag–N–C. It is shown that the latter structure gives unreasonable force constants, and that therefore the cyanides are probably bound to the silver through the carbon atom. Relative amplitudes of the atoms during the vibrations are shown. A.

535.343

7747. INFRARED SPECTRUM OF HYDROGEN SULFIDE IN THE 2.6-MICRON REGION. C.M.Savage and T.H.Edwards.
J. chem. Phys., Vol. 27, No. 1, 179-81 (July, 1957).

The infrared absorption spectrum of hydrogen sulphide (H_2S), in the region from 3730 cm^{-1} to 4030 cm^{-1}, has been measured under high resolution. Calibration was made from emission lines of argon, observed in the second order, using Edser–Butler bands. The absorption has been assigned to two overlapping combination bands, a type A band $(n_1,n_2,n_3) = (0,1,1)$ at 3789.07 cm^{-1}, and a type B band (1,1,0) at 3779.23 cm^{-1}, plus overlapping water vapour absorption. The excited state inertial parameters in cm^{-1} giving the best fit to the data were found to be

	A*	B*	C*
(0,1,1)	10.517	9.124	4.619
(1,1,0)	10.595	8.985	4.603

A.

535.343

7748. DOUBLE TRANSITIONS IN THE INFRARED SPECTRUM OF SOLID HYDROGEN.
H.P.Gush, W.F.J.Hare, E.J.Allin and H.L.Welsh.
Phys. Rev., Vol. 106, No. 5, 1101-2 (June 1, 1957).

The infrared fundamental band (4130-4760 cm^{-1}) of solid H_2 has been recorded with a grating spectrometer having spectral slit width 2 cm^{-1}. The Q branch has two components with frequencies near the Raman frequencies of the solid, and weak lines occur at the calculated position of the corresponding Raman lines. These correspond to rotation–vibration transitions in a single molecule. Strong lines occur at frequencies corresponding to a vibrational transition in one molecule accompanied by rotational transition in the ground vibrational state of a second molecule. R.C.Seymour

535.343

7749. INTENSITIES OF INFRARED BANDS IN SOLUTION. I. BENZENE SOLUTIONS. E.E.Ferguson.
J. chem. Phys., Vol. 26, No. 5, 1265-9 (May, 1957).

It is shown that the molar extinction coefficients of band maxima of infrared "inactive" fundamentals of benzene in solution are markedly sensitive to the nature of the solvent. CS_2, C_6H_5Br, C_6H_5Cl, and C_5H_5N enhance the inactive benzene fundamentals while CCl_4, cyclohexane, and several normal paraffins diminish the extinction coefficients. The extinction coefficients are shown to change linearly with solvent concentration for C_6H_6–CCl_4 and C_6H_6–CS_2 solutions. The intensity changes in solution are shown to correlate with an approximate calculation of intermolecular dispersion forces between benzene and solvent molecules. The inactive fundamentals of several methylene halides also exhibit this "solution sensitivity". The technique of enhancing inactive fundamentals in solutions is shown to be useful for the purpose of identification of these fundamentals in infrared spectra. A.

535.343 : 535.375.5

7750. INFRARED AND RAMAN SPECTRA OF FLUORINATED ETHYLENES. VII. 1, 1-DIFLUORO-2,2-DIBROMOETHYLENE. R.Theimer and J.R.Nielsen.
J. chem. Phys., Vol. 26, No. 6, 1374-7 (June, 1957).

For Pt VI, see Abstr. 1075 (1956). The infrared absorption spectrum of gaseous CF_2:CBr_2 has been obtained with a double-pass spectrometer equipped with NaCl and CsBr prisms and with a 1 m cell. The Raman spectrum of the compound in the liquid state has been photographed with a linear dispersion 15 A/mm at 4358 A. Polarization ratios were measured for the stronger Raman bands. The 12 fundamental vibrational wave-numbers have been assigned as follows: 1718 (a_1), 1307 (b_1), 1005 (a_1), 898 (b_1), 598 (a_1), 572 (b_2), 399 (b_1), 390 (b_2), 324 (a_1), 203 (a_1), 168 (b_1), and 151 (a_2) cm^{-1}. The 3 lowest are for the liquid, the others for the gaseous state. The observed spectra have been interpreted in detail. Thermodynamic properties of the compound in the ideal-gaseous state have been calculated for four temperatures above the boiling point. A.

535.343 : 535.375.5

7751. VIBRATIONAL SPECTRA OF POLYETHYLENES AND RELATED SUBSTANCES. J.R.Nielsen and A.H.Woollett.
J. chem. Phys., Vol. 26, No. 6, 1391-400 (June, 1957).

Fairly complete Raman spectra have been obtained of polyethylenes of different crystallinities (Marlex 50, hydrogenated Marlex 50, Marlex 20, and DYNH), Venezuela wax, n-$C_{28}H_{58}$, n-$C_{36}H_{74}$, and stearic acid. The infrared spectrum of Marlex 50 has been investigated with a spectrometer equipped with LiF, NaCl and CsBr prisms. On the basis of the unit cell and the space group, $V_h{}^{16}$, determined by X-ray analysis, the eight Raman-active unit cell fundamentals of crystalline polyethylene have been assigned as follows: Skeletal deformations 1061 ($a_g + b_{1g}$) and 1131 ($b_{2g} + b_{3g}$); CH_2 rocking 1168 ($b_{1g} + a_g$); CH_2 twisting 1295 ($b_{3g} + b_{2g}$); CH_2 wagging 1415 ($b_{2g} + b_{3g}$); CH_2 deformation 1440 ($a_g + b_{1g}$); sym. CH stretching 2848 ($a_g + b_{1g}$); asym. CH stretching 2883 cm^{-1} ($b_{1g} + a_{1g}$). In terms of these and four of the infrared-active fundamentals assigned by previous workers, it has been possible to assign all but three or four of the 60 observed infrared bands of Marlex 50. A few bands are ascribed to end groups or to amorphous polyethylene. The infrared-active CH_2 wagging and twisting fundamentals (both of species $a_u + b_{1u}$) are extremely weak and apparently masked by the corresponding bands of the amorphous phase. A.

535.343

7752. PURE ROTATIONAL ABSORPTION SPECTRA OF THE METHYL HALIDES IN THE SPECTRAL REGION 100-600 μ.
E.D.Palik and K.Narahari Rao.
J. chem. Phys., Vol. 26, No. 6, 1401-4 (June, 1957).

Rotational absorption lines of the methyl halides CH_3Cl, CH_3Br, CH_3I, CH_3F and CD_3F have been measured for the first time in the region 80 to 15 cm^{-1} (125 to 660 μ). The results obtained are discussed with the aid of the molecular constants of these molecules derived from microwave data. A.

535.343 : 539.133

7753. VIBRATIONAL SPECTRUM AND STRUCTURE OF THE TROPYLIUM ION. W.G.Fateley, B.Curnutte and E.R.Lippincott.
J. chem. Phys., Vol. 26, No. 6, 1471-81 (June, 1957).

The infrared and Raman spectra of tropylium ion, $C_7H_7^+$, are presented and discussed in terms of possible structures. An assignment of the fundamental frequencies has been made for a D_{7h} structure and used to carry out a normal coordinate analysis. The Wilson FG technique was used to calculated valence force symmetry constants and valence force constants. A comparison of the vibrational spectrum and force constants with those for benzene indicates a striking similarity between the two structures. The structure of tropylium ion was concluded to be a planar aromatic D_{7h} molecule ion. A.

535.343 : 539.132

7754. INFRARED SPECTRA AND FORCE CONSTANTS OF CYANOACETYLENE. G.C.Turrell, W.D.Jones and A.Maki.
J. chem. Phys., Vol. 26, No. 6, 1544-8 (June, 1957).

The infrared spectra of gaseous, liquid, and solid cyanoacetylene, H–C≡C–C≡N, have been observed in the region from 450 cm^{-1} to 3400 cm^{-1}. Six of the seven fundamental vibrational frequencies expected for cyanoacetylene on the basis of a linear structure have been assigned and the remaining frequency has been estimated from observed combination bands. A force constant calculation has been carried out using a simple valence potential function. A.

535.343 : 539.132

7755. VIBRATIONAL SPECTRA AND MOLECULAR STRUCTURE OF SOME HALOGENATED METHYL CYANIDES.
S.C.Wait, Jr and G.J.Janz.
J. chem. Phys., Vol. 26, No. 6, 1554-60 (June, 1957).

The series of halogenated methyl cyanides: CCl_3CN, CCl_2FCN, $CClF_2CN$, and CF_3CN, presents the interesting case where the substituent, X, in the CX_3 group is progressively replaced by an atom of greater electronegativity. The present communication reports the infrared and Raman spectra and vibrational assignments for the fundamental bands of the molecules in this series. Comparison of the results clearly shows regularities in certain fundamentals (C≡N stretch, C–C≡N symmetric and antisymmetric bends, C–F symmetric and antisymmetric stretches) which may be attributed to the changes in the force field caused by increasing electronegativity of the CX_3 group. Force constants are calculated for CX_3CN molecules belonging to the C_{3v} point group by the Wilson FG matrix method, the potential function containing all possible second degree terms. The limits of the invariancy of the force constants are examined in this series. A.

535.343 : 539.132

7756. VIBRATIONAL SPECTRUM OF DIMETHYLPHOSPHINE.
H.C.Beachell and B.Katlafsky.
J. chem. Phys., Vol. 27, No. 1, 182-5 (July, 1957).

The infrared spectrum of gaseous dimethylphosphine and the Raman spectrum of the liquid have been obtained. Tentative assignments for the fundamental vibrational frequencies and an interpretation of the observed spectra are given. A.

535.343 : 539.133

7757. MICROWAVE SPECTRUM, DIPOLE MOMENT AND STRUCTURE OF DIFLUOROSILANE. V.W.Laurie.
J. chem. Phys., Vol. 26, No. 6, 1359-62 (June, 1957).

The microwave spectra of several isotopic species of difluorosilane, SiH_2F_2, have been investigated in the region from 12 000 to 38 000 Mc/s. Rotational constants have been determined and the following structural parameters calculated for SiH_2F_2 : r_{SiH} = = 1.471 ± 0.007 A, r_{SiF} = 1.5767 ± 0.001 A, ∠HSiH = 112° 1' ± 30', ∠FSiF = 107° 56' ± 6'. An independent determination of the structure of SiD_2F_2 was also carried out with the following results: r_{SiD} = 1.469 ± 0.010 A, r_{SiF} = 1.5764 ± 0.001 A, ∠DSiD = 113°11' ± 45', ∠FSiF = 107° 57' ± 10'. Rotational constants for the vibrationally excited state ν_4 have been determined for both SiH_2F_2 and SiD_2F_2, and certain structural parameters determined. The variation of effective structure upon isotopic substitution is discussed. Measurements on the Stark effect of the ground vibrational state of SiH_2F_2 give a value of 1.54 ± 0.02 D for the dipole moment. Values for the excited state ν_4 = 1 and for SiD_2F_2 were also measured and agree within the experimental error with the SiH_2F_2 ground-state value. A.

535.34

7758. THEORETICAL STUDY OF THE HYPERFINE STRUCTUR IN THE INVERSION SPECTRA OF THE DEUTERO-AMMONIAS. G.F.Hadley.
J. chem. Phys., Vol. 26, No. 6, 1482-95 (June, 1957).

The energy splittings in the inversion spectra of $N^{14}D_3$, $N^{14}HD_2$ and $N^{14}DH_2$ caused by nitrogen and deuteron quadrupole interaction with the molecular electric field, the interactions of the nuclear sp with the molecular magnetic field, and the spin–spin interactions are found. The molecular coupling scheme of Van Vleck is used to treat the Hamiltonian to second order in the electronic energies. Group theory is used to select wave-functions which simplify the solution of the secular equations. For $N^{14}D_3$ thirteen constants app in the energy expressions. Order of magnitude estimates for eleve of these constants can be made using data from the experimental w on $N^{14}H_3$. No estimate is made of the deuteron quadrupole coupling constants. With $N^{14}HD_2$ and $N^{14}DH_2$ twenty-four constants appear i each case. Order of magnitude estimates can be made for only nin of these. A

535.343 : 529.78

7759. FREQUENCY SHIFT IN AMMONIA ABSORPTION.
K.Matsuura, Y.Sugiura and G.M.Hatoyama.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1301 (Dec., 1956).

Reports observation of a frequency shift with time (after fillin of the absorption cell) in the (3,3) line of NH_3, amounting to 400 ± 100 c/s in two days. J.Hawgoo

535.343 : 529.78

7760. FREQUENCY SHIFT IN AMMONIA ABSORPTION DUE T SELF-BROADENING. K.Matsuura, Y.Sugiura and G.M.Hatoyama
J. Phys. Soc. Japan, Vol. 12, No. 3, 314 (March, 1957).

Preliminary measurements have been made upon the frequen shift of the (3,3) line in the microwave spectrum of ammonia with pressure. It has been observed that the frequency shift is proport al to line-width, i.e. (1.8 ± 0.1) × 10^{-2} Mc/s per Mc/s width. R.W.Nicho

535.3

7761. MICROWAVE SPECTRUM OF ETHYL CHLORIDE.
R.S.Wagner and B.P.Dailey.
J. chem. Phys., Vol. 26, No. 6, 1588-93 (June, 1957).

The spectrum has been investigated and accurate values for t rotational constants B and C for several isotopic species have bee obtained. For $C_2H_5Cl^{35}$, B = 5493.8 Mc/s, C = 4962.3 Mc/s, and fo $C_2H_5Cl^{37}$, B = 5379.1 Mc/s and C = 4867.1 Mc/s. Two deuterated species have been studied. For trans $CH_2DCH_2Cl^{35}$, B = 5098.8 Mc and C = 4637.5 Mc/s. The rotational constants for gauche $CH_2DCH_2Cl^{35}$ are B = 5297.6 Mc/s and C = 4784.9 Mc/s. The follo ing model reproduces these constants to within 4 Mc/s: d C–C = 1.5495 A, d C–H = 1.101 A, d C–D = 1.090 A, < HCH = 110° 00', < CCCl = 110° 30', d C–Cl = 1.7785 A. From the structural data obtained for the deuterated ethyl chlorides it has been possible to establish the staggered configuration as the equilibrium configura ion. The quadrupole analysis shows that eqQ along the C–Cl bon axis is −70.07 Mc/s for Cl^{35} and −55.03 Mc/s, for Cl^{37}, indicating an ionicity of 25%. The torsional frequency has been estimated to be 236 cm^{-1} and the barrier height is 3.4 kcal/mole.

535.3

7762. MICROWAVE SPECTRUM OF ETHYL BROMIDE.
R.S.Wagner, B.P.Dailey and N.Solimene.
J. chem. Phys., Vol. 26, No. 6, 1593-6 (June, 1957).

The spectrum has been investigated and accurate values for t rotational constants B and C and the asymmetry parameter b have been obtained. For $C_2H_5Br^{79}$ B = 3 804.5 Mc/s, C = 3 522.5 Mc/s, b = −0.00487949 and for $C_2H_5Br^{81}$ B = 3 781.5 Mc/s, C = 3 503.0 Mc and b = −0.00522977. The following model reproduces these constants to within 2 Mc/s: C–C 1.5495 A, C–H 1.110 A, C–Br 1.9400 A, ∢C–C–H 110° 00', ∢C–C–Br 110° 30'. Analysis of the quadrupole hyperfine structure indicates that eqQ along the C–Br bo axis is 537.5 Mc/s for $C_2H_5Br^{79}$ and 450.9 Mc/s for $C_2H_5Br^{81}$. Tw transitions have not been able to be fitted by first-order or secon order nondegenerate quadrupole theory. The torsional frequency estimated to be 202 cm^{-1} and the barrier height is 2.80 kcal/mole

535.3

7763. INFRARED ABSORPTION OF THREE-LAYER FILMS.
P.A.Silberg.
J. Opt. Soc. Amer., Vol. 47, No. 7, 575-8 (July, 1957).

The infrared absorption of three-layer films as presented he

is a generalization of Hilsum's solution to the problem (Abstr. 5475/1954). This infrared absorption is dependent on the optical parameters of the film, which in Hilsum's calculation were the same for the entrance and exit film. The present calculation considers different optical parameters for the entrance and exit film; an absorption of over 95% is obtainable. A.

535.349 : 539.156

MODULATION OF A LIGHT BEAM BY PRECESSING ABSORBING ATOMS. See Abstr. 7317

535.37 : 537.533.2

7764. INFLUENCE OF PRESSURE AND DISLOCATIONS ON THE ELECTRON EMISSION AND LUMINESCENCE OF SODIUM CHLORIDE. A.Bohun.
Czech. J. Phys., Vol. 6, No. 5, 496-504 (Oct., 1956). In German.

It is well known that pressure and dislocation content have a marked effect on the cold emission and luminescence of solids. For example if a large pressure is suddenly applied to either coloured or non-coloured crystals of the alkali halides NaCl or KCl electron scintillation phenomena occur in crystals which can show luminescence phenomena. The scintillations are more pronounced for the crystals containing colour centres. Plastic deformation of photochemically coloured single crystals of NaCl is studied and causes similar behaviour in thermionic emission and thermoluminescence as is observed in crystals containing R-centres. Photochemically coloured natural crystals show similar behaviour to those deliberately coloured and plastically deformed. C.A.Hogarth

535.37

7765. SOME EXPERIMENTAL RESULTS OF INVESTIGATIONS ON THE INTERNAL PHOTOEFFECT IN MIXED (ZnS,CdS):Cu CRYSTAL PHOSPHORS. M.Borisov, S.Kŷnev [Kŭnev] and A.Zlateva.
C.R. Acad. Bulg. Sci., Vol. 8, No. 1, 13-16 (Jan.-March, 1957). In Russian.

Presents the results of experiments with powder specimens at room temperature and at 230° C, using the dielectric-loss method. Four phosphors were studied, containing 0, 25, 50 and 100% CdS, respectively, and activated with 0.01% Cu; the wavelength of excitation light varied between 365 and 578 μ. In the case of phosphors with 0 or 25% CdS the regular kinetics of the internal photoeffect was observed; with the two other phosphors and wavelengths 546 and 578 μ, more involved kinetic curves were obtained. It was also established that the conductivity v. temperature curves of phosphors with 0 and 25% CdS showed maxima at temperatures above room temperature; these maxima were shifted towards higher temperatures when the phosphor remained in darkness for a relatively long period between excitation and heating. The maxima flattened out when the phosphors were irradiated with infrared light between excitation and heating. F.Lachman

535.37 : 537.226.2

7766. PECULIARITIES OF THE KINETICS OF PHOTODIELECTRIC LOSSES IN (ZnS,CdS):Cu CRYSTAL PHOSPHORS IN POWDER FORM. S.Kŷnev [Kŭnev].
C.R. Acad. Bulg. Sci, Vol. 9, No. 2, 5-8 (April-June, 1956). In Russian.

It was found that the photodielectric-loss v. excitation-light curve for these phosphors shows a distinct maximum. When such a phosphor is excited by a high light intensity and then placed in darkness, the losses first increase for a short period and then decrease. Other graphs show the dependence of the kinetics of photodielectric losses on the intensity and wavelength of the exciting light and on temperature. F.Lachman

535.37

7767. EMISSION SPECTRUM CORONA IN SOLUTIONS AT LOW TEMPERATURES. É.V.Shpol'skiĭ and L.A.Klimova.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1227-30 (1956). In Russian.

Certain polycyclic condensed aromatic hydrocarbons in solutions of normal paraffins (pentane, hexane and octane) when solid at 77° K give fluorescent and phosphorescent spectrum consisting of narrow bands which are called lines. New photographs of these lines have been taken with instruments of greater resolving power and are reproduced. The lines are identified for different solvents and the effect of different solvents is considered. W.Bardsley

535.37

7768. LUMINESCENCE OF MODIFIED TIN-ACTIVATED STRONTIUM ORTHOPHOSPHATE. H.Koelmans and A.P.M.Cox.
J. Electrochem. Soc., Vol. 104, No. 7, 442-5 (July, 1957).

The introduction of Al, Zn, Mg, Ca, or Cd in $Sr_3(PO_4)_2$ produces a new crystal phase which is probably isomorphous with $\beta Ca_3(PO_4)_2$. Activated with tin this Sr orthophosphate gives a strong luminescence with a maximum at about 6300 A under excitation with 2537 A. A.

535.37

7769. ENERGY TRANSPORT BY CASCADE AND RESONANCE PROCESSES IN DOUBLY ACTIVATED PHOSPHORS.
E.W.Claffy and C.C.Klick.
J. Electrochem. Soc., Vol. 104, No. 7, 445-7 (July, 1957).

A method, using quantum efficiency measurements, is described for obtaining the efficiency of energy transfer from sensitizer to activator centres in doubly activated phosphors when both centres have allowed transitions. From these measurements and applying the theory of resonant transfer it is concluded that, for NaCl:Ag Cu, both cascade and resonant transfer mechanisms are important and that the resonant transfer process increases more rapidly with concentration than does the cascade process. A.

535.37 : 621.397.621 : 621.385.832

7770. LUMINOPHORS FOR COLOUR TELEVISION BASED ON ZnS.ZnSe.
E.I.Blazhnova, A.I.Mokrintseva and V.I.Kas'yanova.
Zh. tekh. Fiz., Vol. 26, No. 12, 2784-5 (1956). In Russian.

Simple methods for preparing ZnS.ZnSe : Ag, ZnS.ZnSe : Cu, and ZnS : Ag : Ni, with, respectively, green, red, and blue luminescence, are described. Brightness (B) was found to be high, and varied linearly with current density (1-10 $\mu A/cm^2$) for 15 kV electrons. Decay time to 1% initial B was 5×10^{-3} sec. 400 hours exposure to 1 $\mu A/cm^2$ of 15 kV electrons gave less than 5% change in B. Colour coordinates are given. C.H.L.Goodman

535.371

7771. THE DECAY OF THE LUMINESCENCE OF CRYSTAL PHOSPHORS OF THE ZnS TYPE. R.Seiwert.
Abhandl. Dtsch. Akad. Wiss. Berlin, Kl. Math. Phys. Tech., 1956; publ. 1957, No. 8, 22 pp. In German.

The Riehl–Schon energy band model for phosphors is used to derive decay curves for ZnS phosphors. Activator centres at one level above the valence band and traps at one depth below the conduction band are assumed. In the first treatment radiationless transitions are neglected but are later introduced together with assumption of distributed trapping levels. The agreement and differences between various theories of decay are also discussed. G.F.J.Garlick

535.371 : 539.132

7772. OBSERVATION OF THE RELATIVE POLARIZATIONS OF ELECTRONIC TRANSITIONS. R.Williams.
J. chem. Phys., Vol. 26, No. 5, 1186-8 (May, 1957).

The polarization of fluorescence of several aromatic systems in a rigid glass of propylene glycol at −78° C has been determined. Polarized exciting radiation absorbed in a single electronic band was used, enabling the determination of the polarization of higher electron transitions relative to that of the lowest singlet–singlet transition. Results are in agreement with current theoretical ideas for anthracene and several of its derivatives. Results for peri-condensed systems suggest the need for a more thorough examination of the free electron model for this type of system. A.

535.371 : 537.312.5

7773. EFFECT OF SURFACE CONDITION ON THE FLUORESCENCE AND SURFACE PHOTOCONDUCTIVITY OF ANTHRACENE. F.R.Lipsett, D.M.J.Compton and T.C.Waddington.
J. chem. Phys., Vol. 26, No. 6, 1444-5 (June, 1957).

When large crystals of anthracene are polished with abrasive powders and solvents, and are then exposed to air or oxygen for several days, the intensity of fluorescence and the hard vacuum value of the surface photoconductivity decrease markedly. With cleaved crystals or crystals grown from solution, however, the fluorescence remains unchanged, and the photocurrent alters in a different fashion. It is suggested that the abrasion of the polishing process facilitates the production of a film of anthracene peroxide or anthraquinone, which in turn causes the effect observed. A.

535.371

7774. USE OF INTERPOLATION THEORY IN THE STUDY OF PHOSPHORESCENCE. J.M.Honig.
J. chem. Phys., Vol. 26, No. 6, 1454-62 (June, 1957).

It is shown that data pertaining to the intensity of the afterglow radiation of phosphors must lie within definite bounds if these data are to be represented by the simple first order or second order decay schemes, modified by the introduction of distribution functions for

the electron traps. These extremal functions are evaluated, without requiring a knowledge of the actual trap distribution, by application of interpolation theory. It is pointed out that if in any time interval the experimental data fall outside the prescribed bounds this is a clear indication that the corresponding simple decay scheme is inapplicable to the data. Under favourable conditions the interpolation theory will therefore give a clearcut indication whether the data follow a first- or second-order scheme or whether more complex mechanisms are required in their interpretation. A.

535.371

7775. STUDY OF THE SCINTILLATION PROCESS.
E.R.Hardwick and W.G.McMillan.
J. chem. Phys., Vol. 26, No. 6, 1463-71 (June, 1957).

A phenomenological time-dependent relation between phosphor concentration and emission intensity, including effects of self-absorption, is derived for scintillation solutions. The dependence of the integrated intensity equation on concentration of phosphor and quencher is tested experimentally in several ways using α irradiation, and found to give agreement within the (occasionally large) experimental error. Application of this equation to measurements of the decline in scintillation efficiency of anthracene crystals on bombardment with α-particles suggests a method of obtaining the effective exciton "range", for which ~3000 A is estimated as a lower limit. The question of the mechanism of energy transfer is discussed, and some photographic data are presented which indicate that the large (~1 mm) transfer distances previously observed by Ageno et al. in similar experiments may have been due to phosphor photon absorption and re-emission. A.

535.371 : 534.321.9

7776. CHANGES IN THE LUMINESCENCE OF CONTINUOUSLY EXCITED ZINC SULPHIDE SCREENS UNDER ULTRASONIC ACTION. M.Leistner and L.Herforth.
Naturwissenschaften, Vol. 44, No. 3, 59 (1957). In German.

The screens were coupled to a 800 kc/s ultrasonic source and irradiated with u.v. The emission from long after-flow ZnS:Cu phophors increased when the source was switched on and decreased on switching off. ZnS:Ag phosphors with no after-glow exhibited an ultrasonic quenching effect. J.Franks

535.372

7777. FLUORESCENCE SPECTRA OF METHYL BENZOATE, M-CHLOROTOLUENE AND M-BROMOTOLUENE. D.C.Biswas.
Indian J. Phys., Vol. 30, No. 11, 565-9 (Nov., 1956).

Fluorescence spectra given by methyl benzoate in the visible region in the solid state at -180^0 C and in dilute solutions in ethylene chlorohydrin and n-heptane have been investigated using ultraviolet light as exciting radiation. An analysis of the bands due to the crystals of the pure substance shows that ν_0-band is at 25451 cm^{-1} and the other bands are due to transitions in which the various vibrational frequencies of the molecule are coupled with the electronic state of this molecule. The spectra due to the solutions are different from those due to the pure substance and the solvent molecules are observed to exert a great influence on the spectrum. The fluorescence spectra due to meta chloro and meta bromotoluene have also been investigated and the results have been compared with the spectra due to other similar molecules. A.

535.372

7778. ON THE FLUORESCENCE IN DIAMOND EXCITED BY X-RAYS. S.N.Sen and B.M.Bishui.
Indian J. Phys., Vol. 30, No. 12, 620-5 (Dec., 1956).

The spectra excited by X-rays in seven specimens of diamond of Type I and one specimen of diamond of Type II have been photographed. The fluorescence efficiency at the 4156 A band and ultraviolet absorption limits of the specimens were known. It has been observed that all the specimens of diamond of Type I show continuous fluorescence extending from 5200 A to 3900 A and only one specimen shows an absorption band at 4155 A in the continuous fluorescence. The diamond of Type II also shows a very weak continuous fluorescence extending from 4045 A to 5049 A. It has been concluded from these results that the particular type of impurity which produces the fluorescence band at 4156 A is not solely responsible for the continuous fluorescence produced by X-rays, but other impurities can produce the continuous fluorescence under X-ray excitation. It has further been observed that the intensity of extra Laue spots in these diamonds reported earlier cannot be correlated with fluorescence under X-ray excitation. It has been pointed out that this fact corroborates the conclusion drawn earlier by Sirkar and Sen (1956) that the extra spots in Laue photographs of diamond are due to either mosaicity or irregularities of the spacings in the crystal and not due to chemical impurity. A.

535.375.

7779. HIGH RESOLUTION RAMAN SPECTROSCOPY OF GASES. VIII. ROTATIONAL SPECTRA OF ACETYLENE, DIACETYLENE, DIACETYLENE-d_2, AND DIMETHYLACETYLENE.
J.H.Callomon and B.P.Stoicheff.
Canad. J. Phys., Vol. 35, No. 4, 373-82 (April, 1957).

For Pt VII, see Abstr. 276 (1957). The pure rotational Raman spectra of acetylene (C_2H_2), diacetylene (C_4H_2 and C_4D_2), and dimethylacetylene (C_4H_6) have been photographed with a 21 ft grating spectrograph. The rotational constants were found to be $B_0(C_2H_2) = 1.1769$ cm^{-1}, $B_0(C_4H_2) = 0.14689$ cm^{-1}, $B_0(C_4D_2) = 0.12767$ cm^{-1}, and $B_0(C_4H_6) = 0.1122$ cm^{-1}. An analysis shows that $r_0(C-H)$ in diacetylene is shorter than in acetylene and cyanoacetylene; in dimethylacetylene at least one of the carbon—carbon bonds is longer than in the closely related molecule methylacetylene. A

535.375.5 : 621.327.53

7780. A WATER-COOLED MERCURY ARC LAMP FOR THE EXCITATION OF RAMAN SPECTRA.
L.A.Woodward and D.N.Waters.
J. sci. Instrum., Vol. 34, No. 6, 222-4 (June, 1957).

A modified Toronto-type mercury vapour lamp, suitable for the excitation of Raman spectra, is described. It is constructed throughout of Pyrex and is water cooled, not only at the electrodes, but all along the whole length of the arc (approximately 185 cm). An inverted-U shape is adopted, so as to allow free expansion of the inner arc tube relative to the cooling jacket and thus render expansion bellows unnecessary. Current—voltage characteristics are given for the range 10-32 amperes. The intensity of emission of each of the mercury lines 4046, 4358 and 5461 A is determined by photographic spectrophotometry as a function of lamp current or wattage. For a given current the light output is found to be slightly lower when the lamp is running with full cooling than when it is running as an ordinary Toronto arc with cooling of the electrodes only; but with full cooling higher currents can be used and thus greater light outputs attained. However, the rate of increase of intensity with increase of current is found to fall off at higher values; so that, for given wattage, a single lamp gives less light than several in parall

535.375.

7781. RAMAN SPECTRUM OF GASEOUS 1-FLUORO-1-CHLOROETHYLENE. J.R.Nielsen and J.C.Albright.
J. chem. Phys., Vol. 26, No. 6, 1566-7 (June, 1957).

The Raman spectrum of gaseous $CFCl:CH_2$ has been obtained with the aid of a multiple-reflection Raman tube and a 3-prism glass spectrograph of linear dispersion 15 A/mm at 4358 A. All but one of the 12 vibrational fundamentals and several overtone or combination bands have been measured. The results are discussed.

535.376 : 539.2

7782. THE DAMAGE TO PLASTIC SCINTILLATORS BY IONIZING RADIATIONS. I.M.Rozman and K.G.Tsimmer (Zimmer
Atomnaya Energiya, Vol. 2, No. 1, 54-60 (Jan., 1957). In Russian.

Polystyrene scintillators with varying amounts of paraterphenyl and 1,1,4,4-tetraphenylbutadiene were radiated by α- and β-particles and their emission and absorption spectra recorded. The transmission to light diminishes for increased radiation dose within limits this decrease could be expressed as a function of the dose. The luminescent yield decreases with increased exposure to the radiation and the radiation damage causing this is greater for α-particles. An α-radiation dose of 10^{10} erg/gm reduces yield of plastic scintillators by 1/e and this is 50 times bigger than that necessary to damage equally single crystals of anthracene. L.Bove

535.3

7783. ON THERMOLUMINESCENCE SPECTRA.
B.C.Dutta and A.K.Ghosh.
Indian J. Phys., Vol. 30, No. 11, 570-81 (Nov., 1956).

The construction of a rapid-scanning spectrophotometer capable of recording spectra in one second is reported. The thermoluminescence spectra of KCl and its analysis, along with a brief description of the demountable cathode-ray-tube and the temperature recording system used in the experiment, are also given.

535.

7784. SELECTIVE REFLECTION OF RESONANCE RADIATION OF CADMIUM VAPOUR. M.Spitzer.
C.R. Acad. Sci. (Paris), Vol. 224, No. 15, 2036-8 (April 8, 1957). In French.

The selective reflectivities of the 2288 and 3261A resonance li

of Cd at a molten silica—Cd vapour surface have been measured as a function of Cd vapour pressure. The reflectivity rises with pressure and the effect is most marked for the 2288A line.

R.W.Nicholls

535.39 : 537.311.33

OPTICAL CONSTANTS OF SEMICONDUCTORS.
See Abstr. 7094

535.399

7785. SPECTROPHOTOMETRIC METHOD OF INVESTIGATING THE DISPERSION AND ABSORPTION OF HARD SUBSTANCES. M.P.Lisitsa.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 803-5 (1956). In Russian.

A quantitative investigation of the absorption spectrum of a hard substance with polished flat faces depends on an accurate account of the reflection of light. A method is obtained which provides authentic absorption curves and dispersion curves for the two cases considered, namely a plane parallel sheet and a wedge. A comparison is made with curves obtained for gypsum (Abstr. 9678/1956). W.Bardsley

535.417

7786. PROPERTIES OF A FABRY—PEROT INTERFEROMETER WHOSE MIRRORS CONSIST OF INTERFERENCE FILTERS. R.Dupeyrat.
C.R. Acad. Sci. (Paris), Vol. 244, No. 18, 2299-302 (April 29, 1957). In French.

The device is recommended for the interferometric analysis of Raman spectra where troublesome scattering of the exciting radiation takes place, the mirrors of the interferometer being constructed to have a reflectivity very low at the excitation wavelength but high for the Raman rays. E.A.Mussett

535.417

7787. SPECTRAL ANALYSIS BY MEASUREMENT OF INTERFERENCE CONTRAST. W.Weizel and G.Meister.
Forschungsber. Wirtsch.-Verkehrsmin. Nordrhein-Westfalen, No. 334, 29 pp. (1956). In German.

A modified form of Michelson interferometer is illuminated with light from a spectrum line and the fringes are focused on a comb diaphragm behind which there is a photomultiplier. The path difference is changed at a constant rate and the a.c. component of the photo-current is a measure of the fringe contrast. This is amplified and plotted by a pen recorder against path difference. The shape of the record depends on the structure of the spectrum line in a manner which the authors have already discussed and illustrated (see Abstr. 2778/1956). G.F.Lothian

535.417

7788. EFFECT OF BACKGROUND INTENSITY ON RESOLVING POWER OF LUMMER GEHRCKE PLATE AND TRANSMISSION ECHELON. K.C.Chaturvedi and M.S.Sodha.
Indian J. Phys., Vol. 30, No. 12, 599-604 (Dec., 1956).

Discusses the effect of background intensity on the resolving power of the Lummer—Gehrcke plate and the transmission echelon. A table and five figures illustrate the variation of resolving power with background intensity for various values of N_e and a. A.

535.42 : 534.213

7789. ON SOME CHARACTERISTICS OF THE DIFFRACTION OF LIGHT BY ULTRASONIC WAVES IN QUARTZ. V.G.Zubov and M.M.Firsova.
Kristallografiya, Vol. 1, No. 5, 555-6 (1956). In Russian.

It is shown experimentally that with shear waves it is possible to get diffraction effects which are as intense as those produced by longitudinal waves, although assertions to the contrary are common in the literature. R.F.S.Hearmon

535.421

7790. EXAMPLES OF HIGH RESOLUTION OBTAINABLE BY DOUBLE PASSING A HIGH QUALITY GRATING. D.H.Rank, A.H.Guenther, C.R.Burnett and T.A.Wiggins.
J. Opt. Soc. Amer., Vol. 47, No. 7, 631-5 (July, 1957).

Critical resolution tests were made near limiting geometric incidence angles on a 7.25 in. wide 300 grooves/mm grating. The importance of double passing a grating to increase the available resolving power is discussed and exhibited by reproductions of the hyperfine structure of Hg λ 4358, λ 5461, λ 15 295. A photograph of a reversal in Hg λ 4358 presents a resolving power well in excess of 1 000 000 which far exceeds the grazing incidence resolving power of the grating used single pass. An analysis of the hyperfine structure of Hg λ 15 295 is given. A discussion of ghost intensities in going from single pass to double pass is also presented. Maximal performance at 4 widely separated wavelengths is given. A.

535.43 : 536.424.1

7791. MOLECULAR SCATTERING OF LIGHT AND THE $\alpha \rightleftarrows \beta$ TRANSITION IN QUARTZ. I.A.Yakovlev, L.F.Mikheeva and T.S.Velichkina.
Kristallografiya, Vol. 1, No. 1, 123-31 (1956). In Russian.

The intensity of the molecular scattering of light in quartz was measured from 15 to 600° C. Opalescence was observed at 573° C, evidence of reversible and intensive formation of small optical heterogeneities near the point of phase transition. R.F.S.Hearmon

535.434 : 541.64

7792. LIGHT SCATTERING MEASUREMENTS ON SOLUTIONS OF HIGH-POLYMERIC SUBSTANCES. H.A.Stuart and H.G.Fendler.
Forschungsber. Wirtsch.-Verkehrsmin. Nordrhein-Westfalen, No. 260, 58 pp. (1956). In German.

Review. The following topics are discussed: The theory of light scattering; apparatus and measurements; determination of molecular weights; and the temperature-dependence of mean molecular length. R.F.Barrow

535.434

7793. TOTAL MIE SCATTERING COEFFICIENTS FOR SPHERICAL PARTICLES OF REFRACTIVE INDEX $n \sim 1.0$. R.B.Penndorf.
J. Opt. Soc. Amer., Vol. 47, No. 7, 603-5 (July, 1957).

The total Mie scattering coefficient K for $n \cong 1.0$ has been computed for the normalized size parameters ρ = 0(0.2) 15(0.5) 17 and for the first ten maxima and minima up to ρ = 64. A formula for the position of the extrema is derived and the results of the computations are listed. For large ρ the total Mie scattering coefficient can be represented by a simple sine function with steadily decreasing amplitude. A.

535.434

7794. MONOCHROMATIC MEASUREMENT OF THE VOLUME SCATTERING OF NATURAL WATERS. J.E.Tyler.
J. Opt. Soc. Amer., Vol. 47, No. 8, 745-7 (Aug., 1957).

A laboratory method is proposed for measuring, as a function of wavelength, the scattering per unit volume of distilled and natural waters. The method employs special fixtures and techniques on the G.E. spectrophotometer. It is best suited to hydrosols in which scattering and absorption are not excessive. A.

535.5 : 539.23

7795. NOTE ON THE LIMITS OF THE POLARIMETRIC METHOD OF THIN FILM MEASUREMENTS. A.Vašíček.
J. Opt. Soc. Amer., Vol. 47, No. 6, 565-6 (June, 1957).

Details are given to support the statement that the method is able to indicate the existence of films having atomic dimensions and should permit accurate measurements for a film of thickness 10 A. D.G.Avery

535.514.4

7796. OPTICAL PROPERTIES OF NEW ULTRAVIOLET POLARIZING FILTERS. G.I.Distler.
Kristallografiya, Vol. 1, No. 2, 218-20 (1956). In Russian.

The filters (extended films of polyvinyl alcohol) have polarizing properties between 240 mμ and 750 mμ. R.F.S.Hearmon

535.514.4

7797. DEVELOPMENT AND INVESTIGATION OF THERMALLY STABLE POLARIZATION FILTERS. G.I.Distler and E.V.Parvova.
Kristallografiya, Vol. 1, No. 2, 221-7 (1956). In Russian.

See preceding abstract. Thermally stable polaroid for the visible spectrum was produced from dehydrated films of polyvinyl alcohol. Curves of dichroism are given for a number of specimens and the nature of the dichroism investigated by extending the measurements to the infrared. R.F.S.Hearmon

535.557 : 541.64

7798. STREAMING BIREFRINGENCE OF POLYMER SOLUTIONS: ANISOTROPY OF INTERNAL FIELDS. M.Čopič.
J. chem. Phys., Vol. 26, No. 6, 1382-90 (June, 1957).

In the case of nonvanishing difference between indexes of refraction of the polymer and the solvent, the anisotropy of the internal electric field contributes a new term, called the form anisotropy, to the difference of polarizabilities of the long chain molecule. The form anisotropy is proportional to the square of the difference between indexes of refraction of the solvent and the polymer; hence it is responsible for the parabolic dependence of the streaming birefringence on the index of refraction of the solvent. Moreover, the form anisotropy is dependent upon the molecular weight of the polymer and on the nature of the solvent in contrast to the intrinsic anisotropy, which is a function of the internal constitution of the long

chain molecule only. Different effects, caused by the presence of the form anisotropy, are discussed using the dumbbell model for the soft and the rigid macromolecules for illustration. Some experimental data obtained on polystyrene in different solvents are compared with the theory. A.

535.566.2 : 541.64

7799. OPTICAL ACTIVITY OF A SOLUTION OF MACROMOLECULES IN A HYDRODYNAMIC FIELD. I.Tinoco,Jr.
J. chem. Phys., Vol. 26, No. 5, 1356-7 (May, 1957).

The rotation in radians cm^{-1} of linearly polarized light (wavelength λ_0 in vacuo) by a solution of refractive index n is, according to Kirkwood (1937) given by $\theta = [16\pi^3(n^2+2)/3\lambda_0^2](N/v)g$. The number of molecules per unit volume is N/v. In this paper values of g for a macromolecular solution subjected to a velocity gradient is calculated. The macromolecules are taken as rigid ellipsoids of revolution. H.G.Jerrard

535.642

7800. UNIVERSAL, DIGITAL TRISTIMULUS INTEGRATOR. W.E.White and D.L.MacAdam.
J. Opt. Soc. Amer., Vol. 47, No. 7, 605-11 (July, 1957).

An electronic digital tristimulus integrator with interchangeable punched-tape programmes corresponding to different illuminants or receptors has been constructed as an accessory for a recording spectrophotometer. The selected-ordinate principle is used. At least one hundred ordinates are used for the Y integrations. The numbers of X and Z ordinates used are such as to eliminate the need for the adjustment factors usually used. The tristimulus values are presented visually. A.

535.642

7801. PROPAGATION OF ERRORS IN TRISTIMULUS COLORIMETRY. I.Nimeroff.
J. Opt. Soc. Amer., Vol. 47, No. 8, 697-702 (Aug., 1957).

The uncertainty ellipse equation is developed for the general case of propagation of errors in tristimulus colorimetry, where spectral tristimulus values as well as spectral radiance factors are deemed uncertain. Two applications are presented as special cases. In the first, uncertainty in chromaticity coordinates for spectrum colours, uncertanties of spectral tristimulus values are based on the C.I.E. standard observer system and the 2^0 and 10^0 field systems derived from Stiles' data by Judd and Kelly. In the second, uncertainties in chromaticity coordinates of fluorescent light sources, uncertainties in spectral emittances are based on five sets of data for one source. It is important that an international standard-observer system be specified not only by mean tristimulus values of the spectrum but also by their variances; otherwise the significance of the departure of an individual experimental datum from that by the standard observer cannot be assessed. A.

535.642.2

7802. EMPIRICAL DERIVATION OF THE C.I.E. LUMINOSITY CURVE FROM COLOR MIXTURE DATA. R.E.Wienke.
J. Opt. Soc. Amer., Vol. 47, No. 7, 622-5 (July, 1957).

The investigation tested the scalar additivity of luminance by generating a luminosity curve from radiances weighted by the appropriate luminosity coefficients. A Cohen multichromatic colorimeter was utilized because it presents near monochromatic spectral components of high radiance. The standard wavelengths were selected at 10 mμ intervals from 400 to 700 mμ and were specified by primaries at 470, 550, and 630 mμ. The radiance of each of these four components was then measured with a thermopile and galvanometer. These radiances were transformed to an equal energy spectrum and reduced to luminance. The luminances were then summed to test the Law of Additivity of Luminance. If the law is valid the resulting curve should be a good approximation to the C.I.E. luminosity curve. It was found the derived curve was not a good approximation because it was displaced toward the blue portion of the spectrum. New luminosity coefficients were derived in order to produce a better fit, and the implications of these new coefficients are briefly discussed. A.

535.653.8

7803. HORTICULTURAL COLOUR CHART NAMES WITH MUNSELL KEY. D.Nickerson.
J. Opt. Soc. Amer., Vol. 47, No. 7, 619-21 (July, 1957).

A Munsell key is provided for the 800 samples in the two-volume edition of the Horticultural Colour Chart published 1939/40 by the British Colour Council in cooperation with the Royal Horticultural Council. The charts are known also as the Wilson Colour Charts. References are included for keys published for other colour charts. A.

535.

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.

7804. THE THEORY OF COMPENSATORS. Y.Väisälä.
Ann. Univ. Turku. Ser. AI, No. 24, 24 pp. (1956). In German.

The theory of compensators used for measuring small optical path differences is outlined. The equations governing the path differences introduced are derived for wedge and rotating types. The possibility of designing achromatic systems is shown and typic calculations are given. R.W.Fis

535.8 : 531.719.2

7805. IMPROVING THE ACCURACY OF RANGE FINDING BY A ORDER OF MAGNITUDE. M.Plaot.
J. Opt. Soc. Amer., Vol. 47, No. 6, 565 (June, 1957).

Accuracy in range finding usually depends upon the magnificat of the optics, this being limited by "image boil" and need to identif the target. An arrangement using a bright artificial star object an a rangefinder with astigmatic lenses is described. The astigmatic diffraction pattern can be viewed by a microscope with 600 × magn fication to give extreme accuracy. A improvement by a factor of 60 over conventional methods is claimed. R.W.Fi

535.8

7806. INFRARED TRANSMITTING GLASSES.
N.J.Kreidl, R.A.Weidel and H.C.Hafner.
J. Opt. Soc. Amer., Vol. 47, No. 6, 567-8 (June, 1957).

Transmission curves are given for several calcium aluminate glasses; the long-wave limit varies from 4.8 to 5.8 μ. Refraction data are given. G.F.Lothia

535.8

7807. A MICROSCOPE WITH ELASTIC CONTROL OF FOCUSING. M.Locquin.
C.R. Acad. Sci. (Paris), Vol. 244, No. 19, 2378-80 (May 6, 1957). In French.

The focusing arrangements for high-powered microscopes depend for their smoothness and stability upon the quality of the tangent screws, racks etc. traditionally used for this purpose. A new principle is described using elastic deformation of a massive microscope-stand to obtain a very smooth focusing motion. R.W.Fi

HEAT 536

536.2 : 537.323 : 537.311

7808. ELECTRICAL CONDUCTIVITY, THERMAL CONDUCTIVITY, THERMAL E.M.F. AND HALL AND NERNST CONSTANTS FOR AMORPHOUS SUBSTANCES WITH ELECTRONIC CONDUCTIVITY. A.I.Gubanov.
Zh. tekh. Fiz., Vol. 27, No. 1, 3-11 (1957). In Russian.

Theoretical. The temperature dependence of the above quanti is calculated for the following substances: (i) liquid metals, (ii) amorphous valence semiconductors and (iii) amorphous ionic semiconductors. The method takes account of the scattering of co duction electrons by the absence of long-range order. The equatio derived are also valid for the same classes of substance with hole conductivity. A.F.Brov

536.2.01 : 537.2

7809. THERMODYNAMICAL THEORY OF THERMAL CONDUCTION OF DIELECTRICS UNDER ELECTRIC FIELDS. S.Mascarenhas.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1118-21 (May, 1957).

The abnormal heat transmission of a fluid dielectric under electrical fields can be conveniently described as a cross-effect between thermal and electrical forces. The case of low fields for plane cell is studied when convection effects are absent. The converse effect, i.e., the variation of the electrical conductivity with the thermal force, is also considered.

536.2.02 : 541.1

7810. THERMAL CONDUCTIVITY OF GAS MIXTURES IN CHEMICAL EQUILIBRIUM. J.N.Butler and R.S.Brokaw.
J. chem. Phys., Vol. 26, No. 6, 1636-43 (June, 1957).

A general expression applying to the steady state has been derived which permits calculation of the increase in thermal conduct ivity due to chemical reaction in mixtures of gases in chemical eq librium. In addition to the gas composition, heats of reaction and

binary diffusion coefficients among the component gases are required. In the case of a simple dissociation, the thermal conductivity may be related to the equilibrium heat capacity. This suggests a possible method for estimating heat transfer in various practical systems with dissociating gases. Approximate calculations for dissociation of diatomic molecules at equilibrium show that the thermal conductivity may be an order of magnitude greater than in nonreacting mixtures. Calculations for the systems $2NO_2 \rightleftharpoons N_2O_4$ and $6HF \rightleftharpoons (HF)_6$ are in satisfactory agreement with experiment. A.

536.21

7811. THERMAL CONDUCTIVITY OF INDIUM ANTIMONIDE. A.D.Stuckes.
Phys. Rev., Vol. 107, No. 2, 427-8 (July 15, 1957).

The thermal conductivity of indium antimonide of varying purity has been measured by a comparative method from 40°C to 425°C. The electronic component of the conductivity has been calculated for each specimen and hence the lattice thermal conductivity has been deduced. Within the limits of experimental error InSb appears to behave according to conventional theory. A.

536.212.2 : 537.311.31

7812. THERMAL AND ELECTRICAL CONDUCTIVITY OF RHODIUM, IRIDIUM, AND PLATINUM. G.K.White and S.B.Woods.
Canad. J. Phys., Vol. 35, No. 3, 248-57 (March, 1957).

Measurements are reported of the thermal and electrical conductivities of the transition elements Rh, Ir, Pt in a state of high purity; the rapid rate of decrease of the "ideal" thermal and electrical resistivities with temperature, particularly in Rh and Ir, suggests that s–d transitions are not a dominant resistive mechanism at low temperatures in these metals, in contrast to palladium, iron, and nickel, which were studied previously. The electrical resistivity of platinum, is in general agreement with the earlier results of de Haas and de Boer (1934); the quadratic dependence on temperature observed below 10°K suggests that electron–electron collisions may well be an important factor in this metal. A.

536.212.2 : 537.311.31

7813. CONDUCTIVITY OF α-MANGANESE. G.K.White and S.B.Woods.
Canad. J. Phys., Vol. 35, No. 3, 346-8 (March, 1957).

Measurements are reported of the electrical and thermal resistance of annealed and unannealed specimens of α-Mn from 2°K up to room temperature. The electrical resistance of an annealed specimen exhibits a shallow minimum near 100°K and falls rapidly below 50°K; below 20°K the resistance is of the form $\rho = \rho_0 + BT^2$. The behaviour of the thermal resistance is also anomalous. E.H.Sondheimer

536.24 : 532.517.4

HEAT TRANSFER TO TURBULENT FLOW IN A CURVED CHANNEL. See Abstr. 7646

536.241 : 536.48

7814. THERMAL CONTACT IN A PARAMAGNETIC SALT. J.S.Dugdale, D.K.C.MacDonald and A.A.M.Croxon.
Canad. J. Phys., Vol. 35, No. 4, 502-3 (April, 1957).

In order to measure the heat transfer between solid iron ammonium alum and gold wire two samples of salt are crystallized on two wires; the gold wires are connected either by a thick (0.1 inch diameter) copper wire or a bundle of thin manganin wires; the latter have a higher thermal resistance; the perimeter of the cross section of copper and of manganin are made equal, in order to equalize a possible film flow of helium along the wires. One sample of salt is heated and the temperatures of both samples are measured magnetically. From the observed rates of heating and cooling the heat transfer between salt and gold is found to be of the order of 100 erg sec^{-1} deg^{-1}. This figure is much larger than the possible rate of heat convection by helium films. R.Eisenschitz

536.33.08

7815. NON-SELECTIVE INFRARED RADIATION RECEIVERS. II. A.Vaško.
Elektrotech. Obzor, Vol. 44, No. 3, 137-43 (1955). In Czech.

For Pt I see Elektrotech. Obzor, Vol. 44, No. 1, 3-5 (1955). Reviews the theory and design of bolometers. A Wheatstone bridge consisting of four equal resistances is described as the basic model of d.c. bolometers. One of the resistances is the radiation receiver, the second is a compensating and the other two serve as measuring elements. Conditions for optimum sensitivity are derived from analytical considerations. The theory and advantages of a.c. bolometers are given and sensitivity expressions established from the solution of differential equation. The author refers to a paper by Billings, Hyde and Barr (Abstr. 1797/1947) for a discussion of the accuracy of this apparatus. Thermistor bolometers and bolometers based on superconductivity principles are described. E.Erdélyi

536.33.08 : 621.317.794

7816. AN EVAPORATED GOLD BOLOMETER. E.Archbold.
J. sci. Instrum., Vol. 34, No. 6, 240-2 (June, 1957).

The construction of a bolometer is described in which the element — of evaporated gold supported by a thin plastic film — is 2.6 mm long, 0.2 mm wide and has a resistance of 15 ohms. In vacuum it has a sensitivity of 1.5 V/W and a minimum detectable energy of 3.6×10^{-10} W, both measured at 10 c/s. The time constant in vacuum is 7 msec. A.

536.4 : 537.311.33

7817. THERMAL AND ELECTRICAL PROPERTIES OF TUNGSTEN OXIDE (WO_3). S.Sawada.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1237-46 (Dec., 1956).

These properties were observed over a wide range of temperature. An entirely new anomaly was found at 1230°C, where the rate of sublimation increased abruptly. The amounts of anomalous heat were found to be 330, 450, 280 and 120 cal/mol at the 330°C, 740°C, 910°C and 1230°C transitions respectively, the entropy change being 0.55, 0.45, 0.23 and 0.08 cal/mol.deg at each of the transition temperatures. Any anomalous heat larger than 6 cal/mol was not observed near the −20°C transition point. At the transition points mentioned anomalies of electrical properties were observed. The d.c. resistance decreases, on heating from room temperature, like a typical semiconductor with the activation energies of nearly 2.2, 0.3, 1.7 and 1.3 eV below 740°C, between 740°C and 910°C, between 910°C and 1230°C and above 1230°C, respectively, the small value as 0.3 eV between 740°C and 910°C being especially noticeable. A non-linearity of the current–voltage relation was observed, indicating some anomalous electrical property of this substance. A.

536.413 : 548.7

7818. X-RAY DETERMINATION OF THE THERMAL EXPANSION COEFFICIENT OF POLYCRYSTALLINE SUBSTANCES IN THE INTERVAL −50 TO +100°C. V.V.Zubenko and M.M.Umanskiĭ.
Kristallografiya, Vol. 1, No. 4, 436-41 (1956). In Russian.

Details are given of the apparatus and technique. The mean coefficient of Al between −46 and +102° C is $24.3 \pm x\ 10^{-6}$ per deg C, and the measurements are compared with those of Wilson (1942). For bismuth between +20 and +92° C the mean coefficients are:

parallel to c axis	$15.4 \pm 1 \times 10^{-6}$ per deg C,
parallel to a axis	$12.8 \pm 1 \times 10^{-6}$ per deg C.

R.F.S.Hearmon

536.413 : 548.7

7819. GRÜNEISEN'S RULE AND THE THERMAL EXPANSION OF METALS. G.B.Mitra and S.K.Mitra.
Nature (London), Vol. 179, 1295-6 (June 22, 1957).

The results of X-ray measurements of the lattice parameters (a_O at 0°K and a_T at T°K) of pure Cu, Al, Ag and Pt are used to plot curves of $(a_O/a_T - a_O)$ against $1/TD(\theta/T)$, where D is the Debye function, in order to verify Simon and Vohsen's form of Grüneisen's rule. The curves, unlike those obtained by Fischmeister (Abstr. 310/1957) for ionic crystals, are nonlinear. S.Weintroub

536.413 : 539.377

THERMAL DEFORMATION OF CRYSTALS. See Abstr. 7467

536.421.1 : 539.893

7820. MELTING POINT OF INDIUM AT PRESSURES UP TO 30 000 Kg/cm². V.P.Butuzov and E.G.Ponyatovskiĭ.
Kristallografiya, Vol. 1, No. 6, 736-7 (1956). In Russian.

The melting point found by differential thermal analysis is 156°C at atmospheric pressure and 280°C at 30 000 Kg/cm². A curve is given showing the dependence of melting point on pressure. No polymorphic transitions were found. R.F.S.Hearmon

536.421.1 : 536.75 : 539.11

FUSION AND STRUCTURAL CHANGE IN METALS. See Abstr. 7249

536.422.1

7821. POLYMERIC GASEOUS SPECIES IN THE SUBLIMATION OF TUNGSTEN TRIOXIDE. J.Berkowitz, W.A.Chupka and M.G Inghram.
J. chem. Phys., Vol. 27, No. 1, 85-6 (July, 1957).

Mass spectrometric study of the gaseous species effusing from a Knudsen cell filled with WO_3 has shown that WO_3(s) sublimes to form the gaseous molecules W_3O_9, W_4O_{12} and W_5O_{15}. From the measured partial pressures for these species and their variations with temperature, ΔH, ΔF^0 and ΔS^0 of sublimation are obtained. A.

536.423.15

7822. MEASUREMENT OF VAPOUR PRESSURES IN THE REGION BELOW 10^{-2} mm Hg. R.Jaeckel and G.Reich.
Forschungsber. Wirtsch - Verkehrsmin. Nordrhein-Westfalen, No. 332, 34 pp. (1956). In German.

The measurements were made with a sensitive vacuum balance which measured the impulse of a molecular beam. A very complete analysis of the experimental technique is given. Measurements were made on diffusion pump fluids including Nacoil-40 ($\log p = 12.95 - 5950/T$), Octoil and other phthalates. A.H.W.Beck

536.423.15

7823. VAPOR PRESSURE DATA FOR THE MORE COMMON ELEMENTS. R.E.Honig.
R.C.A. Rev., Vol. 18, No. 2, 195-204 (June, 1957).

The most recent data available concerning vapour pressures, melting and boiling points, and heats of sublimation have been selected, tabulated, and plotted for 57 elements, many of which are of special interest to workers in the fields of electronics and high-vacuum technique. It has been found convenient to present vapour pressure data graphically as plots of log p (mm Hg) versus log T (deg K), and also to tabulate the absolute temperatures for fixed pressures. This collection contains data published or available before March 1, 1957. A.

536.424 : 537.226.2

7824. PHASE TRANSITIONS AND DOMAIN STRUCTURES IN BARIUM TITANATE AT 120 AND 5°C. I.S.Zheludev and V.F.Parvov.
Kristallografiya, Vol. 1, No. 4, 482-3 (1956). In Russian.

Ciné films of the cubic–tetragonal transition at 120°C and of the tetragonal–rhombic transition at 5°C are reproduced and described. R.F.S.Hearmon

536.424.1 : 535.43

THE $\alpha \rightleftarrows \beta$ TRANSITION IN QUARTZ. See Abstr. 7791

536.445

7825. COEXISTENCE CURVE OF THE TRIETHYLAMINE–WATER SYSTEM. F.Kohler and O.K.Rice.
J. chem. Phys., Vol. 26, No. 6, 1614-18 (June, 1957).

The coexistence curve of the system triethylamine–water has been determined near its lower critical point. The observed critical temperature T_c is 18.33°C. There is evidence of a small horizontal portion of the coexistence curve, which extends from 0.559 to 0.657 volume fraction water, or from 0.907 to 0.936 mole fraction water, though the evidence is not absolutely certain. On the other hand, the results exclude the possibility of an anomalous phase transition in the concentration interval from 0.35 to 0.90 mole fraction water where, according to J.E.Mayer, such an anomalous transition may occur. Outside the small horizontal portion the coexistence curve shows the same cubic behaviour [$(T - T_c)^{1/3}$, or better $(T - T_c + 0.007)^{1/3}$, proportional to the difference of the volume fractions of the phases in equilibrium] as do coexistence curves of systems with upper critical points, but is much flatter, the proportionality factor having a smaller absolute value. A.

536.46 : 535.33

THE SPECTROSCOPY OF FLAMES. See Abstr. 7718

536.461

7826. PHOTOGRAPHIC STUDIES OF TURBULENT FLAME STRUCTURE.
J.Grumer, J.M.Singer, J.K.Richmond and J.R.Oxendine.
Industr. engng Chem., Vol. 49, No. 2, 305-12 (Feb., 1957).

The concept that the turbulent flame brush is composed of a fluctuating, wrinkled, essentially continuous, laminar combustion wave is mainly supported by very short duration schlieren, shadow, and smoke photographs. New experiments reveal the schlieren photography technique to be ambiguous. Observed density gradients have apparent velocities greater than the turbulence intensity, laminar burning velocity, and cold approach flow; changes with turning of the schlieren knife-edge are different for turbulent flames piloted by a laminar hydrogen-air flame and those piloted by heating the port electrically; and are present in the absence of turbulent flame, if a pilot and a turbulent air stream are on. It is concluded that schlieren (and probably shadow and smoke) photography does not prove the existence of a wrinkled laminar wave in the brush. A.

536.48 : 539.185

7827. THEORY OF INELASTIC SCATTERING OF COLD NEUTRONS FROM LIQUID HELIUM. M.Cohen and R.P.Feynman.
Phys. Rev., Vol. 107, No. 1, 13-24 (July 1, 1957).

A measurement of the energy losses of monoenergetic neutrons scattered from liquid He II would permit a determination of the energy v. momentum relation for the elementary excitations (phonons and rotons) in the liquid. A major part of the scattering at a fixed angle arises from production or annihilation of a single excitation and appears as sharp lines in the energy spectrum. From the position of these lines the energy v. momentum relation of the excitations can be inferred. Other processes, such as production or annihilation of multiple excitations, contribute a continuous background, and occur at a negligible rate if the incident neutrons are slow ($\lambda > \sim 4$ A) and the helium cold ($T < 2°K$). The total cross-section data can be accounted for by production of single excitations; the theoretical cross-section, computed from a wave-function previously proposed to represent excitations, agrees with experiment over the entire energy range, within 30%. Line widths in the discrete spectrum are negligible at 1°K because of the long lifetime of phonons and rotons. A

536.4

7828. ADIABATIC OSCILLATIONS IN LIQUID HELIUM II.
F.D.Manchester and J.B.Brown.
Canad. J. Phys., Vol. 35, No. 4, 483-97 (April, 1957).

Oscillations have been observed in an experimental arrangement consisting of an adiabatic container placed in a helium II bath and connected with the bath by means of a "superleak". A "thermal pulse" introduced into the container caused the liquid level to oscillate. Containers of different geometries and employing two different types of superleak were successfully used to observe oscillation. With one of these the temperature dependence of the frequency was measured between 1.39° and 2.065°K and found to be of the form and magnitude expected from the calculations of Robinson (1951). Other features of the oscillations have been investigated. An analogy between the oscillations in an adiabatic container in liquid helium II and those of a gas in a Helmholtz resonator is suggested and discussed. A

536.581 : 621–

7829. A THERMOSTAT USING A RESISTANCE THERMOMETER AND A GALVANOMETER-PHOTOCELL AMPLIFIER.
P.M.Hu and R.W.Parsons.
J. sci. Instrum., Vol. 34, No. 7, 283-5 (July, 1957).

A very simple thermostat has been constructed and tested in a water bath up to 65°C. It has proved capable of keeping the temperature constant to within ± 0.005 deg.C. A salient feature is a simple d.c. voltage amplifier, using a robust galvanometer and two photocells which are connected in adjacent arms of a Wheatstone bridge. The amplifier has a gain of 5×10^6 and is sufficiently sensitive so that circuit operation will occur if the temperature changes by 0.001 deg.C. A

536.628

7830. AUTOMATIC ADIABATIC CALORIMETER SHIELD CONTROL. M.G.Zabetakis, R.S.Craig and K.F.Sterrett.
Rev. sci. Instrum., Vol. 28, No. 7, 497-501 (July, 1957).

An automatic control has been built and operated successfully for approximately 700 hours. It has been used with an existent low-temperature (10 to 300°K) intermittently heated calorimeter in runs of up to 100 hours duration. Each control unit consists essentially of a different thermocouple, high-sensitivity taut suspension galvanometer, a set of four photomultiplier tubes, a relay servomechanism, a reversible a.c. motor and gear train and two on-off control relays. The observed behaviour of the control and the internal consistency of the data obtained during its use indicate that the precision with which it controls the shield temperature is comparable with that obtainable from a trained human operator.

536.631 : 539.1

7831. ON THE ELECTRONIC COMPONENT OF THE SPECIFIC HEAT OF TRANSITION METALS. R.Blanpain.
Bull. Soc. Roy. Sci. Liège, Vol. 26, No. 4, 165-81 (April, 1957). In French.

The recent values of the Sommerfeld coefficient for the transition elements, deduced from calorimetric and magnetic data, are compared with the number of valence electrons and allow establishment of an empirical structure of the d-band. This is compared with theoretical curves of density of the d-states. Further experimental research is suggested, particularly for the manganese group, for which theoretical predictions do not seem to be confirmed by experience.

536.631 : 539.11

7832. ON THE ELECTRONIC SPECIFIC HEAT OF RHENIUM. R.Blanpain.
Bull. Soc. Roy. Sci. Liège, Vol. 26, No. 2, 182-8 (April, 1957). In French.

The value of the Sommerfeld coefficient γ for rhenium is deduced from calorimetric data in the field of intermediate temperatures (20 to 300°K) and compared with the values obtained from the magnetic study of this superconductor. The specific heat of Re may be represented between 30 and 280°K by $C_V = D(\theta_{res.}) + \gamma T$ where $\theta_{res.} = 279°K \pm 4\%$ and $\gamma = 14.5 \times 10^{-4}$ cal mole^{-1} deg^{-2}. The same value of γ, gives $\theta_V = 316°K$ at 20°K, in agreement with the 310°K value, deduced from electrical resistance measurements. A.

536.631 : 536.48

7833. ON THE SPECIFIC HEAT OF SOLIDS AT LOW TEMPERATURES. T.H.K.Barron and J.A.Morrison.
Canad. J. Phys., Vol. 35, No. 7, 799-810 (July, 1957).

The temperature dependence of the specific heat of solids at very low temperatures is examined, using theoretical models and certain recent experimental results. The temperature region over which the continuum approximation ($C_V = aT^3$) is strictly reliable is shorter than has often been supposed, and the series expansion $C_V = aT^3 + bT^5 + cT^7 + \ldots$ is needed for the analysis of accurate experimental results. For insulators θ_0 can best be estimated from measured specific heats by plotting C_V/T^3 versus T^2; the result is a curve whose intercept at $T^2 = 0$ gives the coefficient of T^3 (and hence θ_0), and whose slope and curvature give additional information about the vibrational spectrum at low frequencies. For metals the usual plot of C_V/T versus T^2 can be used, but here again neglect of curvature may lead to errors in the estimates of γ and θ_0. A brief discussion is given of the low temperature specific heats of a number of solids for which suitable data are available: potassium chloride, lithium fluoride, white tin, tungsten, the noble metals, and elements of diamond structure. A.

536.631 : 536.75 : 536.77

7834. THERMAL PROPERTIES OF ALUMINUM OXIDE FROM 0° TO 1200°K.
G.T.Furukawa, T.B.Douglas, R.E.McCoskey and D.C.Ginnings.
J. Res. Nat. Bur. Stand., Vol. 57, No. 2, 67-82 (Aug., 1956).

Accurate measurements of the heat capacity of α-aluminium oxide (corundum) which is a recommended heat-capacity standard, from 13° to 1170°K are described. An adiabatic calorimeter was used from 13° to 380°K and a drop method was used with a Bunsen ice calorimeter from 273° to 1170°K. The results are compared in the range 273° to 380°K, where the two methods overlap. From the data, smoothed values of the heat capacity, enthalpy, entropy, and Gibbs free energy from 0° to 1200°K are derived and tabulated. A.

536.631 : 548.7

7835. [CONTRIBUTION] TO THE THEORY OF THE SPECIFIC HEAT OF LAMINATED STRUCTURES AT LOW TEMPERATURES. E.S.Itskevich and V.M.Kontorovich.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 175-7 (1957). In Russian.

This note is concerned with crystals where the interatomic bonds between certain crystallographic planes are markedly weaker than the bonds within the planes. On account of the flexural modes of vibration the elastic spectrum differs from Debye's expression even in the range of low frequencies. Theoretical formulae taking account of the contribution of the flexural modes are compared with specific heat data for graphite in the range of 1-21°K. Agreement is fair. R.Eisenschitz

536.631 : 538.221

HEAT CAPACITY OF NiZn FERRITES. See Abstr. 7218

536.654 : 539.132

7836. THERMODYNAMICS OF THE Zr–ZrO_2 SYSTEM. THE DISSOCIATION ENERGIES OF ZrO AND ZrO_2.
W.A.Chupka, J.Berkowitz and M.G.Inghram.
J. chem. Phys., Vol. 26, No. 5, 1207-10 (May, 1957).

A mass spectrometric analysis of vapours effusing from a Knudsen cell containing either solid ZrO_2 or a mixture of Zr and ZrO_2 powders has been employed to determine the vapour pressures, and hence the heats of sublimation of these species. Combined with published thermodynamic data, these results yield 7.8 ± 0.2 eV and 14.5 ± 0.2 eV for the dissociation energies of ZrO and ZrO_2, respectively. Previous work is shown to be in error due to the volatility of TaO. A.

536.655

7837. HEATS OF VAPORIZATION OF 1,1,2-TRICHLOROETHANE, 1-PROPANOL, AND 2-PROPANOL; VAPOR HEAT CAPACITY OF 1,1,2-TRICHLOROETHANE. K.D.Williamson and R.H.Harrison.
J. chem. Phys., Vol. 26, No. 6, 1409-11 (June, 1957).

Heats of vaporization have been determined at various temperatures. The vapour heat capacity of 1,1,2-trichloroethane has been measured at 96.76°C, 148.33°C, and 201.11°C. A.

536.655 : 539.132

7838. THERMODYNAMIC FUNCTIONS OF 1,1,2-TRICHLOROETHANE. R.H.Harrison and K.A.Kobe.
J. chem. Phys., Vol. 26, No. 6, 1411-15 (June, 1957).

The thermodynamic functions have been calculated by the method of statistical mechanics. An assignment of the fundamental frequencies of vibration has been made and a barrier to internal rotation has been selected. The calculated heat capacities agree with experimental values. A.

THERMODYNAMICS 536.7/.8

536.7 : 530.162

7839. ON A RELATION BETWEEN FLUCTUATION-DISSIPATION THEOREM AND IRREVERSIBLE THERMODYNAMICS. J.Hori.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1220-7 (Dec., 1956).

It is first shown that, for some special simple impedances, the stochastic equation describing the fluctuation of macroscopic variables, which is suggested by the fluctuation-dissipation theorem, comes out to be equivalent to the Langevin equation appearing in ordinary irreversible thermodynamics. This does not mean, however, that ordinary irreversible thermodynamics cannot describe any variables other than those with simple impedances. It is secondly shown that, on the contrary, any macroscopic variable whose impedance is of the form

$$Z(i\omega) = z^{-1}/(i\omega) + z^0 + (i\omega)z^1 + \sum_j c_j/(i\omega - p_j),$$

can be described within the framework of ordinary irreversible thermodynamics. This is proved by the fact that one can construct, starting from irreversible-thermodynamical equations and using the method of eliminating inner variables, a variable whose impedance is of the above-mentioned form and whose fluctuation-spectrum exactly coincides with that given by the fluctuation-dissipation theorem. A.

536.7

7840. THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES AS APPROXIMATION TO THE ENSKOG THEORY OF GASES. I. SINGLE COMPONENT SYSTEMS. H.G.Reik.
Z. Phys., Vol. 148, No. 2, 156-76 (1957). In German.

A brief summary of the essential results of the Enskog theory of a single component gas is given, and hence entropy expressions which correspond to the various Enskog distributions are obtained. These results are then compared with expressions for the entropy as given by the thermodynamics of irreversible processes. The conditions are then found for which these two approaches yield results which are approximately the same. P.T.Landsberg

ELECTRICITY 537

537.122

7841. A NEW MODEL OF CLASSICAL ELECTRON. P.Caldirola.
Nuovo Cimento Suppl. (Ser. 10), Vol. 3, No. 2, 297-343 (1956).

The theory of the point electron in classical electromagnetism encounters remarkable difficulties both in connection with the convergence of integrals and with the appearance, in the equations of motion, of derivatives of higher order of the velocity. On the other hand, models of finite electrons come up against the exigencies of relativistic invariance. In the present paper an attempt is made to overcome these difficulties by using a point electron model obeying finite difference equations of motion, rather than differential ones. Such a model allows the development of a satisfactory theory of classical radiation, and gives a very simple picture of the positron as a particle moving in space–time in a direction opposite to that of the time. It is interesting to note that the electron has some internal

motions, the excited states of which might be related to the existence of particles of higher mass (as, for instance, μ mesons). The anomalous magnetic moment can, in this theory, be explained in classical terms. It is very difficult, however, to associate such an electron model with an electromagnetic field (even if modified with respect to one of a Maxwellian type). One finds that the equations of motion obtained according to this theory have only a few analogies with those deduced from a field theory of a non-local type. The quantization of this theory seems to encounter very serious difficulties. G.Martelli

ELECTROSTATICS. DIELECTRICS 537.2

537.213 : 518.5 : 621.317.729

7842. COMMENTS ON "ELECTROLYTIC TANK, DESIGN AND APPLICATIONS". H.K.Farr.
Rev. sci. Instrum., Vol. 28, No. 4, 296-7 (April, 1957).

See Abstr. 2153 (1957). Principle of the double tank can be extended, with some complications, to sloping and non-circular tanks. Simulation of wires producing magnetic fields at low frequencies can be approximated by a distribution of metal pins connected to individual current sources. An exact analogue can be obtained for magnetic fields of rotational symmetry. References are given to support these claims. K.C.Garner

537.226.1 : 532.74

7843. DIELECTRIC SATURATION OF ASSOCIATED LIQUIDS. J.A.Schellman.
J. chem. Phys., Vol. 26, No. 5, 1225-30 (May, 1957).

Equations are developed which take into account the effect of association in liquids on dielectric saturation. The treatment emphasizes the strong relation between dielectric properties and the mean fluctuation of electric moment of fluids in the absence of electric fields. For water the results indicate a saturation effect about five times the value predicted by the equations of Van Vleck, which is not applicable to associated liquids. The equations derived are rigorously applicable only to systems where the field strength is not subject to variations over distances of microscopic dimensions (like all other dielectric theories). However, when applied to a dielectric 5 A from a singly charged ion they indicate that saturation effects are negligible. If the present treatment is granted, the decrease in dielectric constant which arises from saturation is of the same order of magnitude as the increase in dielectric constant caused by electrostriction. A realistic theory of dielectrics in very strong fields, must simultaneously include both effects. A.

537.226.2 : 541.182.3

7844. THE DIELECTRIC CONSTANT OF SOLID PARTICLE AEROSOLS. C.M.Crain, D.C.Thorn and J.E.Boggs.
J. phys. Chem., Vol. 61, No. 6, 806-7 (June, 1957).

The dielectric constants of aerosols consisting of polystyrene, silver iodide or iron powder suspended in dry nitrogen, or oil smoke suspended in air have been measured at a frequency of 9400 Mc/s. The results are fitted well by a simple expression, in spite of the complexity and wide diversity of the systems studied. The observed data were well fitted by this equation even in cases where magnetic as well as electric interactions would be expected. A.

537.226.2

7845. ON THE PULSE BREAKDOWN OF PLASTIC FILMS AT HIGHER TEMPERATURES. Y.Inuishi.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1299 (Dec., 1956).

Measurements with square pulses of durations from 10^{-8} to 10^{2} sec are reported on films of polyethylene and polyethylene terephthalate (Mylar). The results show a fall in strength with longer pulse duration at the higher temperatures (60-80°C). It is concluded that electronic breakdown can only be observed with short pulses, otherwise secondary effects such as local heating or space charges intervene. K.W.Plessner

537.226.2 : 621.3.015.5.029.5 : 621.315.618

7846. THE ELECTRICAL BREAKDOWN OF GASEOUS DIELECTRICS AT HIGH FREQUENCIES. R.R.T.Fatehchand.
Proc. Instn Elect. Engrs, Monogr. 242R, publ. June, 1957 (Vol. 104C, 489-95).

Republication of the monograph abstracted in Abstr. 6145 (1957).

537.226.2 : 548.

7847. BEHAVIOUR OF THE DOMAINS OF ROCHELLE SALT IN ALTERNATING ELECTRIC FIELDS. I.S.Zheludev and R.Ya.Sit'ko
Kristallografiya, Vol. 1, No. 6, 689-91 (1956). In Russian.

Micro-ciné films of the changes in domain structure at frequencies of 32 and 1000 c/s and a field strength of about 50 V/cm are shown. R.F.S.Hearmo

537.226.2 : 548.7

7848. THE QUESTION OF ANOMALOUS POLARIZATION OF ROCHELLE SALT CRYSTALS. V.A.Yurin.
Kristallografiya, Vol. 1, No. 6, 734-6 (1956). In Russian.

On exposure to radiation from Co^{60}, hysteresis in the field–polarization curve of Rochelle salt diminishes and ultimately disappears, the curve degenerating to a reversible straight line. At the same time, the peaks in the permittivity–temperature curve at the Curie points become less pronounced and on prolonged exposure they, too, disappear. R.F.S.Hearmo

537.226.

7849. DOUBLE HYSTERESIS LOOP OF $(Pb_{\lambda}Ca_{1-\lambda})TiO_3$ CERAMICS. E.Sawaguchi, T.Mitsuma and Z.Ishii.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1298 (Dec., 1956).

Solid solutions containing 60-100% $PbTiO_3$ had tetragonal structures and were definitely ferroelectric. The 50% composition which was pseudo-cubic, had a Curie temperature of 80°C and showed a normal ferroelectric hysteresis loop immediately after cooling from 200°C. Within 10 minutes, however, the loop became constricted at the centre, assuming a propeller-like shape. Reheating or application of a high a.c. field temporarily restored the normal shape. K.W.Plessne

537.226.2 : 536.42

PHASE TRANSITIONS AND DOMAIN STRUCTURES IN BARIUM TITANATE AT 120 AND 5°C. See Abstr. 7824

537.226.2.08 : 621.317.335

7850. MEASUREMENT OF THE COMPLEX DIELECTRIC CONSTANT OF LIQUIDS AT MICROWAVES USING THE EFFECT OF MULTIPLE REFLEXION. P.Hedvig, L.Németh and G.Schay.
Acta phys. Hungar., Vol. 6, No. 2, 337-8 (1956).

The transmitted intensity in a waveguide is measured as a function of sample thickness, standing waves either in front or behind the sample being avoided by suitably placed attenuators. Formulae are given for calculating ϵ and $\tan\delta$. The accuracy is estimated as 1% for ϵ and 2% for $\tan\delta$, assuming a liquid of mediu loss. K.W.Plessne

537.226.2.08 : 538.221.0

MEASUREMENT OF PERMITTIVITY OF FERRITES. See Abstr. 7221

537.226.3 : 532.7

7851. MULTIPLE RELAXATION TIMES IN NONRIGID SOLUTE MOLECULES. M.Davies and R.J.Meakins.
J. chem. Phys., Vol. 26, No. 6, 1584-7 (June, 1957).

Describes the first detailed investigation of the dielectric behaviour of liquid solutions of large solute molecules possessing small polar groups capable of rotation about a chemical bond. Thr hindered hydroxy-compounds are chosen as examples and their dielectric properties in Decalin solution are measured at frequenc up to 2.4×10^{10} c/s which includes the region of maximum absorpt In each case two distinct absorption regions are obtained, in contrast to the results for the rigid molecule o-dichlorobenzene, whic gives a Debye curve with a single relaxation time. A comparison the calculated and observed dipole moments supports the theory that in each case the lower frequency absorption is due to the rota ion of the main part of the molecule and the higher frequency abso tion is due mainly to the independent orientation of the hydroxyl group by rotation about the C–O bond. The activation energies an frequency factors for the dielectric mechanisms are determined, where possible, from the displacement of the absorption with temperature. The activation energies for complete molecule rotation and for independent hydroxyl orientation are similar. The frequen factor for the hydroxyl mechanism is larger, however, and this accounts for the higher frequency of the absorption due to this mechanism.

537.226

7852. IRRADIATION EFFECTS IN BOROSILICATE GLASS. B.Gross.
Phys. Rev., Vol. 107, No. 2, 368-73 (July 15, 1957).

Irradiation of thick samples of borosilicate glass with high-energy electrons introduces space charges into the dielectric, the

decay of which is extremely slow at room temperature. The charged dielectric shows a behaviour similar to that of an electret; charges are induced on adjacent conductors and short-circuit discharge currents are observed during heating. The nature of the charges of the dielectric, annealing effects, and discharge mechanism were investigated. It is shown that the dielectric contains charges of two types: A negative charge constituted by arrested irradiation electrons and a positive compensation charge. A.

537.228.1 : 539.216

7853. ON THE PIEZOELECTRIC EFFECT OF SILK FIBERS.
E.Fukada.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1301 (Dec., 1956).

Carefully dried bundles of parallel fibres were compressed at 120°C forming a solid block of orientated fibres. The greatest piezoelectric effect occurred for pressure applied at 45° to the axis of orientation, similarly to wood. When the fibres slip over each other the electric polarization appears in the direction of the force. The piezoelectric constant was obtained by the converse piezoelectric effect, giving 1.5×10^{-8} c.g.s. e.s.u. The effect may be due to the highly crystalline monoclinic silk fibroin, being the sum effect of the fibroin micelle in each fibre. The larger piezoelectric effect would be observed if the cerisin layer were removed from the fibre before preparing the specimens. J.J.Phipps

537.228.1

7854. THE PIEZOELECTRICITY OF ICE.
D.Rossberg and S.Magun.
Naturwissenschaften, Vol. 44, No. 3, 59 (1957). In German.

Sensitive measurements on single crystals of ice failed to show a piezoelectric effect and therefore the structure appears to be non-polar. The existence of twinning on a microscopic scale with polar axes in an anti-parallel array cannot, however, be ruled out. K.W.Plessner

537.228.1 : 534.131

THE ELECTRICAL EQUIVALENT CIRCUIT OF DAMPED FLEXURAL VIBRATIONS IN PIEZOELECTRIC BARS.
See Abstr. 7673

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.1

7855. SOME SCATTERING PROBLEMS IN CONDUCTION THEORY. P.G.Klemens.
Canad. J. Phys., Vol. 35, No. 4, 441-50 (April, 1957).

An expression is derived for the scattering of electrons by inhomogeneous strain fields in terms of the scattering of electrons by low-frequency lattice vibrations, as deduced from the low-temperature intrinsic thermal resistivity and the lattice thermal conductivity. This is applied to the scattering of electrons by dislocations and stacking faults. An expression for the scattering of lattice waves by stacking faults is also derived. The validity of these results is discussed. A.

537.311.3 : 537.323 : 536.2

ELECTRICAL CONDUCTIVITY, THERMAL E.M.F. AND HALL AND NERNST CONSTANTS FOR AMORPHOUS SUBSTANCES WITH ELECTRONIC CONDUCTIVITY. See Abstr. 7808

537.311.31 : 536.48

7856. THE ELECTRICAL RESISTANCE OF SOME METALS AND ALLOYS BELOW 1°K. J.S.Dugdale and D.K.C.MacDonald.
Canad. J. Phys., Vol. 35, No. 3, 271-9 (March, 1957).

Measurements of electrical resistance below 1°K are described, including experiments to estimate the thermal contact resistance between the paramagnetic salt and gold wires which were subsequently used as secondary thermometers. The resistance of a dilute copper alloy, a lithium–magnesium alloy, and a sodium specimen was measured. No change was found in the resistance of sodium which might be correlated with the specific heat anomaly previously reported by Rayne. The resistance below the minimum in the gold and copper specimens showed a marked contrast in behaviour below 1°K. No minimum was found in the resistance of the lithium–magnesium alloy. A.

537.311.31 : 536.48

7857. LOW TEMPERATURE RESISTIVITY OF THE TRANSITION ELEMENTS: COBALT, TUNGSTEN, AND RHENIUM.
G.K.White and S.B.Woods.
Canad. J. Phys., Vol. 35, No. 5, 656-65 (May, 1957).

Experimental values are reported for the electrical resistivity from 1.5° to 300°K and for the thermal resistivity from 2° to 120°K of high purity cobalt, tungsten, and rhenium. The temperature variation of the components of the electrical and of the thermal resistance due to scattering by thermal vibrations is deduced and the possible evidence for the importance of s-d transitions is discussed briefly. The temperature of the superconducting transition in samples of rhenium is found to be close to 1.70°K, the value reported by Hulm (1954). A.

537.311.31

7858. THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTIVITY OF THE β-PHASE TITANIUM–MOLYBDENUM ALLOYS. S.Yoshida and Y.Tsuya.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1206-7 (Nov., 1956).

Measurements are reported over the temperature range from −190°C to 900°C and the concentration range from 12 to 30 wt.% Mo. The temperature coefficients of resistivity for 12 to 17 wt.% Mo alloys become negative below 150°C, with a maximum in the resistivity at lower temperatures. E.H.Sondheimer

537.311.31 : 536.212.2

ELECTRICAL CONDUCTIVITY OF α-Mn. See Abstr. 7813

537.311.31 : 539.11

ELECTRICAL RESISTIVITY AND POTENTIAL ENERGY IN PURE METALS. See Abstr. 7248

537.311.32 : 539.185

7859. ELECTRICAL RESISTIVITY OF GRAPHITE IRRADIATED WITH NEUTRONS. R.W.Attree and O.Dahlinger.
Canad. J. Phys., Vol. 35, No. 4, 462-9 (April, 1957).

Measurements have been made of the changes in the electrical resistance of an artificial graphite which are induced by neutron irradiation and subsequent annealing. The resistivity increases with irradiation; the increase in resistance is partially removed by annealing at 128°C. These changes have been interpreted using Wallace's theory of the electron structure of graphite. The number of atoms displaced by the irradiation has been calculated using the method of Seitz, and is shown to be consistent with the experimental results. A.

537.311.32 : 548.7

7860. IONIC CONDUCTIVITY OF CALCIUM FLUORIDE CRYSTALS. R.W.Ure,Jr.
J. chem. Phys., Vol. 26, No. 6, 1363-73 (June, 1957).

Transference number measurements on pure and doped crystals show that the predominant defect in CaF_2 crystals is the anti-Frenkel disorder type involving equal concentrations of negative ion vacancies and negative ion interstials. The mobilities of the F^- vacancy and F^- interstitial have been determined by measuring the electrical conductivity of crystals doped with NaF and YF_3. The activation energy for mobility of the vacancies varies from 20 ± 1.5 kcal/mole at 200°C to 12 ± 1 kcal/mole at 600°C. For the interstitials, the mobility in the range from 690 to 920°C is given by

$$u = (1.34 \times 10^7)T^{-1} \exp[-(19 \pm 4) \times 10^3/T] \text{ cm}^2/\text{sec volt}.$$

The number of anti-Frenkel defects in the pure crystal in the range from 640 to 920°C is given by

$$n_0 = 2.96 \times 10^{25} \exp[-(16.3 \times 10^3)/T] \text{ cm}^{-3}.$$ A.

537.311.33

7861. FIELD EFFECT AND PHOTO EFFECT EXPERIMENTS ON GERMANIUM SURFACES. I. EQUILIBRIUM CONDITIONS WITHIN THE SEMICONDUCTOR.
W.L.Brown, W.H.Brattain, C.G.B.Garrett and H.C.Montgomery.
Semiconductor surface physics, 111-25. See Abstr. 7092 (1957).

It has been possible to deduce certain aspects of the energy distribution of the fast surface states on etched germanium surfaces from field-induced changes in conductivity and surface recombination velocity. The assumptions underlying the interpretation of these experiments are discussed in some detail. Measured changes in surface capacitance are found to substantiate these assumptions over a limited range. The surface state distribution is composed of a density of states of the order of 10^{11}-10^{12} $(\text{cm}^2 \text{ volt})^{-1}$, slowly varying with energy near the centre of the band gap. The results also require higher densities more than 0.1 eV both above and below the centre. A.

537.311.33 : 539.27

7862. LOW-ENERGY ELECTRON DIFFRACTION STUDIES OF CLEANED AND GAS-COVERED GERMANIUM (100) SURFACES.
R.E.Schlier and H.E.Farnsworth.
Semiconductor surface physics, 3-20, 20-2. See Abstr. 7092 (1957).

An experimental system for electron diffraction studies using beam energies of 50-200 eV and capable of being maintained at a pressure less than 10^{-9} mm Hg is described. It is stated that argon ion bombardment and subsequent annealing results in a clean germanium surface, whereas outgassing alone does not. The hypothesis that on a clean (100) germanium surface the atoms are displaced from their normal positions is supported by the data obtained. Oxygen adsorbs on the surface in approximately germanium lattice positions, and the displaced germanium atoms are restored to the lattice sites. The sticking probabilities for oxygen and hydrogen are approximately 1.4×10^{-2} and 1×10^{-6} respectively.

J.D.Nixon

537.311.33 : 537.312.5 : 537.533.2

7863. ELECTRICAL PROPERTIES OF A CLEAN GERMANIUM SURFACE. P.Handler.
Semiconductor surface physics, 23-40, 40-51. See Abstr. 7092 (1957).

Measurements of work function, photoconductance, surface conductance and field-effect of germanium surfaces, cleaned by the argon sputtering technique, are reviewed. Surfaces so produced are p-type, and have associated with them a high density of surface levels (greater than 2×10^{13} cm^{-2} if they are mono-energetic and perhaps as large as 8×10^{14} cm^{-2} V^{-1} if they are uniformly distributed in energy). These states are identified with Tamm levels. The variation of surface conductance with chemisorption of oxygen, and of the work function with chemisorption of oxygen and hydrogen, is reported. A model, associating the unfilled orbitals of the surface germanium atoms with the effects, is proposed. J.D.Nixon

537.311.33

7864. MOBILITY IN INVERSION LAYERS: THEORY AND EXPERIMENT. J.R.Schrieffer.
Semiconductor surface physics, 55-69. See Abstr. 7092 (1957).

The theory of conduction in a space-charge layer in which the charge carriers are subject to boundary scattering is reviewed. The theory of the anisotropy of surface conductivity, after Ham and Mattis, is outlined and contrasted with the scalar-mass theory. Experimental work is compared with the results to be expected from the computed effective mobility of carriers; support is obtained for the hypothesis of random surface scattering. Should the space-charge field be very high, a discrete set of levels may arise as a consequence of quantization. It is stated that in this event the random surface scattering may broaden the levels, resulting again in a continuum. The simple theory may even in the case of high space charge be adequate to describe the mobility. J.D.Nixon

537.311.33

7865. FIELD EFFECT ON SURFACE CONDUCTANCE AND SURFACE RECOMBINATION.
P.C.Banbury, G.G.E.Low and J.D.Nixon.
Semiconductor surface physics, 70-84. See Abstr. 7092 (1957).

Study of the changes in surface conductance and surface recombination occurring within the first hundred microseconds after capacitive application of an electric field to a surface leads to an evaluation of the capture cross-section of surface states for majority carriers in n-type and p-type material. The surface states involved in these phenomena are designated as the "fast" states, to distinguish them from those which give rise to changes over a period of minutes or so.

537.311.33

7866. SURFACE RECOMBINATION PROCESSES IN GERMANIUM AND THEIR INVESTIGATION BY MEANS OF TRANSVERSE ELECTRIC FIELDS. A.Many, E.Harnik and Y.Margoninski.
Semiconductor surface physics, 85-105, 105-7. See Abstr. 7092 (1957).

The surface recombination velocity was measured as a function of barrier height, giving good agreement with theoretical expectations. Capture cross-sections could again be evaluated (see preceding abstract).

537.311.33

7867. STORAGE OF INJECTED CARRIERS AT SURFACES OF GERMANIUM. B.H.Schultz.
Semiconductor surface physics, 108-10. See Abstr. 7092 (1957).

The paper presents results on hole storage in a semiconducting plate as a function of plate thickness. The effective carrier lifetime was found to increase with diminishing plate thickness. Hole storage with delayed recombination is thus possible at the surface.

537.311.33 : 537.312.5

7868. FIELD EFFECT AND PHOTO EFFECT EXPERIMENTS ON GERMANIUM SURFACES. II. NON-EQUILIBRIUM CONDITIONS WITHIN THE SEMICONDUCTOR.
C.G.B.Garrett, W.H.Brattain, W.L.Brown and H.C.Montgomery.
Semiconductor surface physics, 126-38. See Abstr. 7092 (1957).

Such non-equilibrium phenomena as change of contact potential with "intrinsic" illumination, and the decay of photoconductivity, for various initial surface biases (produced by varying ambients), coupled with field effect modulation of surface conductance, yield results which suggest that the fast traps near the gap centre are acceptor type. It is estimated that the cross-sections for holes and electrons are $\sigma_p \cong 6 \times 10^{-15}$ and $\sigma_n \cong 4 \times 10^{-17}$ cm^{-2}. At high frequencies the field-effect modulation of surface conductance may not be interpreted as a phenomenon in which the bulk germanium is in equilibrium with the surface states, but at frequencies up to 5 Mc/s the dispersion in field effect is negligible. J.D.Nixon

537.311.3

7869. MEASUREMENTS OF INVERSION LAYERS ON SILICON AND GERMANIUM AND THEIR INTERPRETATION.
H.Statz, G.A.deMars, L.Davis, Jr and A.Adams, Jr.
Semiconductor surface physics, 139-67, 167-8. See Abstr. 7092 (1957).

It is proposed that two types of surface states exist, one set being at the semiconductor–oxide interface and the other at the oxide–oxygen interface, and perhaps also within the oxide film. The second type arise primarily from adsorbed gas molecules; in differing ambients they may be acceptor or donor type traps, and determine the initial bias of the surface. Measurements have been made on p–n–p germanium bars, and n–p–n as well as p–n–p silicon bars, the inversion layers being produced on the base regio Steady-state measurements suggest that on silicon the oxide thickness is about 10 A. Non-steady state measurements on silicon sug gest that there is a density of "inner" states of 10^{12} cm^{-2} at 0.45 eV below, and 10^{11}-10^{12} cm^{-2} at 0.42-0.48 eV above the gap centre. In the case of germanium, where only the lower half of the gap has been explored, a set of states has been located at 0.14 eV below the gap centre, of density 10^{11} cm^{-2}. High fields can influence the density of the inner states. Anomalous conductances in the presence of vapours appear; an additional conductance mechanism is suggested. J.D.Nixo

537.311.3

7870. SLOW RELAXATION PHENOMENA ON THE GERMANIUM SURFACE. S.R.Morrison.
Semiconductor surface physics, 169-93, 193-6. See Abstr. 7092 (1957).

Experimental methods of disturbing the charge in "slow surfac states" are discussed. When the disturbing agency is removed, the excess charge in these states generally decays to the equilibrium value in a time of the order of ten to a hundred seconds, the decay being non-exponential and very temperature dependent. Two model the heterogeneous surface model, in which it is postulated that inho mogeneities in the surface are associated with the various relaxat ion times, and the electron transfer model, in which the relaxation times are related to the non-exponential transfer over the surface barrier, are discussed. Neither model satisfactorily accounts for the observed behaviour; perhaps a combination of the two will. J.D.Nixo

537.311.3

7871. EFFECTS OF THICK OXIDES ON GERMANIUM SURFACE PROPERTIES. M.Lasser, C.Wysocki and B.Bernstein.
Semiconductor surface physics, 197-206. See Abstr. 7092 (1957).

The decay of surface conductance changes, produced by the application of steady d.c. fields is studied on both n- and p-type germanium after various oxidizing procedures. As the oxide thickness grows, the decay time also increases, suggesting that the trapping states associated with the oxide lie on the outer surface. For a single oxide thickness the decay period varies with ambient, suggesting that additional levels are formed. It is suggested that, thick oxide films the interactions between the germanium and the outer oxide surface are inhibited. Films of 0.3 microns thickness give decay times that are immeasurably long, and it is found that i this case the surface potential may be varied only slightly as the ambients are changed. It is proposed that thick oxide films may b used in stabilizing the surfaces of germanium devices. J.D.Nix

537.311.33

7872. 1/f NOISE AND GERMANIUM SURFACE PROPERTIES. A.L.McWhorter.
Semiconductor surface physics, 207-25, 226-8. See Abstr. 7092 (1957).

Problems connected with noise generation at semiconductor surfaces are reviewed and discussed and results presented which indicate that the fluctuating charge density in "slow states" is responsible for the so-called excess or 1/f noise found in germanium. The absolute magnitude of the 1/f noise in devices still represents an unsolved problem. In recent models the noise energy is derived from the applied field.

537.311.33

7873. SURFACE STUDIES ON CLEAVED CRYSTALS OF LEAD SULFIDE. W.W.Scanlon.
Semiconductor surface physics, 238-43. See Abstr. 7092 (1957).

Experimental results relating to thin films of lead sulphide and also to surfaces of bulk crystals are presented. These surfaces are evidently highly sensitive to changes of external environment.

537.311.33 : 541.128

7874. BRIDGES OF PHYSICS AND CHEMISTRY ACROSS THE SEMICONDUCTOR SURFACE. P.B.Weisz.
Semiconductor surface physics, 247-58. See Abstr. 7092 (1957).

Gives a general survey of catalytic phenomena, and discusses some of the interesting results which arise from the fact that many large periodic structures (e.g., some organic molecules) have common energy levels and can, in a sense, be likened to semiconducting crystals.

537.311.33 : 541.128

7875. GAS REACTIONS ON SEMICONDUCTING SURFACES AND SPACE CHARGE BOUNDARY LAYERS. K.Hauffe.
Semiconducting surface physics, 259-81, 281-2. See Abstr. 7092 (1957).

Deals with catalytic processes which involve an electron exchange between the semiconductor surface and the surrounding gas, and with the dependence of these processes on the Fermi level at the surface. The general aim is to relate the observations on reaction kinetics to the knowledge of Fermi potentials, space charge distributions, and thermionic work functions.

537.311.33 : 541.128

7876. EXPERIMENTS CONNECTING SEMICONDUCTOR PROPERTIES AND CATALYSIS. G.M.Schwab.
Semiconductor surface physics, 283-95, 295-6. See Abstr. 7092 (1957).

A distinction is made between donor reactions involving electron transfer to the catalyst, and acceptor reactions involving electron loss from the catalyst. The author shows how information concerning the rate-determining step can be obtained from experiments in which the kinetics of a reaction are analysed as a function of donor or acceptor impurity content.

537.311.33 : 537.533.2

7877. LONG TIME WORK FUNCTION CHANGES AS INDUCED BY LIGHT AND ELECTROSTATIC FIELDS.
G.W.Pratt,Jr and H.H.Kolm.
Semiconductor surface physics, 297-321, 321-3. See Abstr. 7092 (1957).

A refinement in the method for measuring contact potentials by the Kelvin procedure allows long time changes, of order 100 minutes, in the work function of gold, germanium and silicon, to be studied. These changes are induced by the application of electric fields and also by optical irradiation. The results obtained are related to the boundary layer theory of charge transfer. It is proposed that the slow surface reaction follows from chemisorbed oxygen acting as acceptor traps, and also that the oxygen chemisorption bond on germanium is polar-covalent. J.D.Nixon

537.311.33 : 541.124

7878. THE OXIDATION OF METALS. N.Cabrera.
Semiconductor surface physics, 327-48. See Abstr. 7902 (1957).

Oxidation theory is reviewed in two parts. The first deals with the formation of thin uniform films covering the entire metal surface. In this case no nucleation is required. The second part discusses the formation of oxide nuclei when the oxidation is initiated by nucleation. In this latter case observations by a number of workers are discussed with reference to such crystal surface inhomogeneities as steps, impurities, and particularly the points where dislocations terminate. J.D.Nixon

537.311.33 : 541.124

7879. THE INTERACTION OF OXYGEN WITH CLEAN GERMANIUM SURFACES.
I. EXPERIMENT. M.Green, J.A.Kafalas and P.H.Robinson;
II. THEORETICAL DISCUSSION. M.Green.
Semiconductor surface physics, 349-61, 362-82. See Abstr. 7092 (1957).

Experiments are described in the course of which germanium crystals were first crushed in high vacuum and in which the subsequent oxygen uptake was kept under observation as a function of time, temperature and pressure. The results led to a proposed model for the structure of the first oxide layer. Its quantitative confirmation depends on the accuracy with which surface areas can be measured by independent methods, e.g., krypton adsorption.

537.311.33 : 541.124

7880. THE HIGH TEMPERATURE OXIDATION OF GERMANIUM. J.T.Law and P.S.Meigs.
Semiconductor surface physics, 383-400. See Abstr. 7092 (1957).

An oriented crystal face is etched, and the oxidation rates, at 500-700° C, are measured by the fall in pressure in a closed system. Additional results are quoted. It is deduced that at high temperatures, 550° C, the process is rate-limited by the diffusion of GeO away from the surface, and is independent of crystal orientation. Below this temperature the (110) plane oxidizes more rapidly than the (100) and (111) planes. The rate is limited at these lower temperatures by the transport of germanium ions from the lattice to the oxide–oxygen surface. J.D.Nixon

537.311.33 : 537.311.31

7881. ON THE TRANSITION TO METALLIC CONDUCTION IN SEMICONDUCTORS. N.F.Mott.
"Semiconductor Meeting Report", 5-13. See Abstr. 6165 (1957).

A discussion is given of the conductivity to be expected from a crystalline array of atoms when the interatomic distance a is varied. It is shown that both for monovalent atoms and divalent atoms the conductivity is zero at T = 0 when a is large, the wave-function of the system being real so that no current is possible. In both types of atom a discontinuous transition to a state showing metallic conductivity is predicted at a definite value of a. For divalent atoms calculations using Bloch orbitals and localized Wannier functions give essentially the same result; for monovalent metals they do not, and correspond to physically different states of the system. Applications are made to the electrical properties of oxides and other compounds of the transition metals and an explanation is advanced of the metallic conductivity of some ferromagnetic compounds, and also to impurity-band conduction in semiconductors, the impurity centres being treated by the usual model as expanded atoms in a uniform dielectric. It is shown that the concentrations at which "metallic" conductivity sets in are not unexpected, but that it is difficult to understand impurity band conduction at lower concentrations unless the semiconductors are "compensated", either chemically or through the presence of dislocations. A.

537.311.33 : 545.8

7882. IMPURITY DETERMINATION IN SILICON.
J.A.James and I.Williams.
"Semiconductor Meeting Report", 15-20. See Abstr. 6165 (1957).

Methods of analysis for small traces of chemical impurities in silicon are discussed since such traces are known to affect the electrical properties. Chemical, spectrographic, mass spectrographic, electrical, infrared absorption and radio-chemical techniques are described. Special reference is made to radio-activation analysis which has detection limits of, for example 1 in 10^{10} for As in Si, and to radiotracer techniques for determination of segregation coefficients. A.

537.311.33

7883. THE CONTROL OF THE PROPERTIES OF SINGLE CRYSTAL SILICON. S.E.Bradshaw and A.I.Mlavsky.
"Semiconductor Meeting Report", 21-6. See Abstr. 6165 (1957).

A method is described whereby a vacuum ambient is used for producing a uniform distribution of certain impurities in single crystals of silicon by balancing segregation against evaporation. By a suitable choice of impurity and ambient various types of p–n junctions can be obtained. A.

537.311.33 : 548.7

7884. DISLOCATIONS IN DIAMOND-TYPE LATTICES.
P.J.Holmes.
"Semiconductor Meeting Report", 27-32. See Abstr. 6165 (1957).

The available evidence on the types of dislocation existing in materials of the diamond structure is summarized, and a distinction

is drawn between macroscopic growth defects and dislocations capable of analytic treatment by current theories. Possible dislocation models of the latter type are described, and their dissociations and interactions are discussed. Some comments are made concerning the correlation between etch-pit and dislocation densities. A.

537.311.33

7885. THE TEMPERATURE DEPENDENCE OF MINORITY CARRIER LIFETIME IN P-TYPE GERMANIUM AND SILICON. M.S.Ridout.

"Semiconductor Meeting Report", 33-7. See Abstr. 6165 (1957).

Electron lifetime in p-type germanium and silicon has been found to be sensitive to injection level. Assuming that the Shockley—Read recombination statistics are obeyed, τ_o, the lifetime extrapolated to zero injection level, and $\tau_{po} + \tau_{po}$, the sum of the reciprocals of the capture probabilities of electrons and holes respectively, have been evaluated as a function of temperature. Results in p-type silicon suggest the existence of two recombination levels. A.

537.311.33

7886. JUNCTION RECTIFIER THEORY. J.S.Saby.

"Semiconductor Meeting Report", 39-48. See Abstr. 6165 (1957).

Previous one-junction and two-junction rectifier theories are compared. An intermediate theory is proposed which accounts for some effects due to non-ideal contacts. The three theories predict similar forward current—voltage dependences: unmodulated current proportional to exp(qV/kT), modulated current proportional to exp(qV/2kT), transition voltage characteristic of the semiconductor. A.

537.311.33

7887. REVERSE CURRENTS AND CARRIER LIFETIMES IN SILICON P—N JUNCTIONS. D.J.Sandiford and J.Shields.

"Semiconductor Meeting Report", 49-54. See Abstr. 6165 (1957).

The results of an investigation into carrier lifetimes and reverse currents over a range of temperatures in silicon alloy junction diodes are presented. It is found that the measured diode carrier lifetime is mainly determined by the treatment of the silicon during the preparation of the diodes. The activation energy for reverse current is 0.7 eV. A comparison between the experimental results and the currents given by saturation current and space charge current theories is made. No agreement is found and it is suggested that surface channel currents are present. A.

537.311.33

7888. OBSERVATIONS ON THE GROWTH OF EXCESS CURRENT IN GERMANIUM P—N JUNCTIONS. A.R.F.Plummer.

"Semiconductor Meeting Report", 55. See Abstr. 6165 (1957).

Summary of the article abstracted in Abstr. 6644 (1956).

537.311.33

7889. SHOT NOISE IN A GERMANIUM FILAMENT. F.J.Hyde.

"Semiconductor Meeting Report", 57-64. See Abstr. 6165 (1957).

Measurement of the electrical noise generated by a near-intrinsic germanium filament when carrying currents of 2.5, 4.5 and 6.5 mA are described, for the frequency range 10 c/s to 1 Mc/s, at temperatures of 45° C, 61° C and 81.5° C. The experimental spectra of the noise in excess of the thermal noise of the filament show "bumps" at the higher frequencies which stand out above a background which decreases with increasing frequency. The bumps are interpreted as shot-noise spectra. A.

537.311.33 : 541.67

7890. A "SEMICONDUCTOR BOND". E.Mooser and W.B.Pearson.

"Semiconductor Meeting Report", 65-70. See Abstr. 6165 (1957).

A shorter version of the article abstracted in Abstr. 8181 (1956).

537.311.33

7891. METHODS OF PRODUCING THIN BASE LAYERS FOR HIGH FREQUENCY JUNCTION TRANSISTORS. R.G.Hibberd.

"Semiconductor Meeting Report", 71-3. See Abstr. 6165 (1957).

537.311.33

7892. THE HIGH POWER GERMANIUM POWER RECTIFIER. T.H.Kinman.

"Semiconductor Meeting Report", 75-6. See Abstr. 6165 (1957).

537.311.33 : 539.217

7893. THE INTERSTITIAL DIFFUSION OF Cu IN PbS SINGLE CRYSTALS. J.Bloem and F.A.Kröger.

"Semiconductor Meeting Report", 77-81. See Abstr. 6165 (1957).

The diffusion of Cu into PbS crystals was studied at low temperatures (100-400° C), where the self-diffusion of Pb or S may be neglected. The diffusion rate depends on the previous history of the crystals and on the ambient gas atmosphere during the diffusion. The activation energy for interstitial Cu diffusion is found to be 0.3 eV. A

537.311.3

7894. HIGH FIELD EFFECTS IN SEMICONDUCTORS. J.B.Gunn and A.F.Gibson.

"Semiconductor Meeting Report", 83-8. See Abstr. 6165 (1957).

A description is given of the variation of electron mobility in germanium with electric field inferred from measurements of the conduction current and radiofrequency absorption under pulse conditions. The electron velocity is found to vary very little over the range 4.5×10^3 - 6×10^4 volt cm^{-1}, and the implication of this result is discussed in connection with the theories of point-contact rectification, small-area junctions, and the mechanism of avalanche injection. Avalanche injection occurs when the minority carriers produced by a multiplying avalance are able to modulate the conductivity of a semiconductor specimen in such a way as to enhance the field in the avalanche region. Devices based on this effect are discussed, and shown to be capable of rapid switching. Variations in electron mobility with field have been observed in the range 10-1000 volt cm^{-1}, both by d.c. and microwave measurements. While the methods do not agree exactly, both indicate the presence of a measurable effect down to the lowest field.

537.311.33 : 537.312.6 : 538.6

7895. INFLUENCE OF CARRIER CONCENTRATION DISTURBANCES ON THE ETTINGSHAUSEN EFFECT. J.Houghton and P.C.Banbury.

"Semiconductor Meeting Report", 89-91. See Abstr. 6165 (1957).

The Ettingshausen effect is discussed for the case of two-carrier systems, consideration being given to influence of surface recombination processes. Experimental results on germanium at room temperature are presented and discussed.

537.311.33 : 537.312

7896. MODULATION OF THE SURFACE CONDUCTANCE OF GERMANIUM. G.G.E.Low.

"Semiconductor Meeting Report", 93-8. See Abstr. 6165 (1957).

The modulation of the surface conductance of germanium by external electric fields is discussed for the case in which only one type of charge carrier plays a significant part. Experimental observations under these conditions are interpreted in terms of surface-state cross-sections for hole or electron capture.

537.311.33 : 537.3

7897. THE ELECTRICAL PROPERTIES OF INDIUM ARSENIDE AND INDIUM ANTIMONIDE. G.R.Antell, R.P.Chasmar, C.H.Champness and E.Cohen.

"Semiconductor Meeting Report", 99-107. See Abstr. 6165 (1957).

Details are given of the method of preparation and purification of the compound InAs. Measurements have been made of Hall coefficient, electrical conductivity and thermoelectric power between room temperature and 500° C for pure specimens and for samples doped with Zn and with Se. It is concluded from the values of thermoelectric power that some degree of degeneracy exists even in pure specimens within the temperature range considered. Making correction for this degeneracy a value for the energy gap at 0° K of 0.50 eV is obtained. The ratio effective electron mass to free electron mass (m_e/m) is calculated at various temperatures. The results suggest that for electrons of mean kinetic energy greater than 0.04 eV the electron mass ratio is approximately 0.055. For kinetic energies less than 0.04 eV the mass ratio decreases. Similar measurements have been made on both pure and n-type specimens of indium antimonide. After correction for degeneracy a value of 0.26 eV for the energy gap at 0° K is obtained. Making allowance for a small degree of impurity scattering in the purest samples it is found that the electron mobility varies approximately as $T^{-1.8}$. It would seem that the difference between this and the covalent scattering law $T^{-1.5}$ can reasonably be accounted for by the degeneracy present in the samples. The electron mass ratio for kinetic energies greater than 0.04 eV is deduced as 0.034. For lower energies the mass ratio decreases towards the cyclotron resonance value. Application of the Mansfield treatment of impurity scattering in partially degenerate semiconductors has been applied to the results obtained for highly impure n-type samples of both indium antimonide and indium arsenide. The observed mobilities can be accounted for within the uncertainty of the parameters involved.

537.311.33 : 537.

7898. THE PROPERTIES OF GALLIUM ARSENIDE. J.T.Edmond, R.F.Broom and F.A.Cunnell.

"Semiconductor Meeting Report", 109-17. See Abstr. 6165 (1957).

The purification of gallium, arsenic and gallium arsenide are

described. Measurement of Hall effect and conductivity over a range of temperature from 1.4°K to 700°C have shown some interesting effects. The highest figures for mobility ($R_H\sigma$) obtained are 4680 $cm^2 sec^{-1} volt^{-1}$ for electrons and 340 for holes at 20°C. For lattice scattering μ_h is approximately proportional to T^{-2} but the variation of μ_e is uncertain. Impurity band conduction in p-type gallium arsenide has been observed. Thermoelectric power measurements yield a value of $m_h^* = 0.5\ m_0$ and $m_e^* = 0.06\ m_0$ approximately at room temperature. Magneto-resistance measurements are given for certain crystal orientations, field strengths, and directions of field. A.

537.311.33 : 536.2.08

7899. MEASUREMENT OF THE THERMAL CONDUCTIVITY OF SEMICONDUCTORS. A.D.Stuckes and R.P.Chasmar.
"Semiconductor Meeting Report", 119-25. See Abstr. 6165 (1957).

A comparison method is described for the measurement of the thermal conductivity of small samples of semiconductors from room temperature up to several hundred degrees centigrade. Pure iron and stainless steels are used as standard reference materials. The problems of accurate temperature measurement and of thermal contacts are discussed in detail. Present investigations have been restricted to the region around room temperature and here an indium mercury amalgam is found to make satisfactory contact between metal and semiconductor surfaces. Preliminary values are given for the thermal conductivity of germanium, silicon, indium antimonide and indium arsenide. The electron contribution to the heat transport in impure n-type indium and antimonide at room temperature is in reasonable agreement with values calculated from conventional theory of kinetic energy transport in a partially degenerate semiconductor. A.

537.311.33 : 536.212

7900. THE THERMAL CONDUCTIVITY OF BISMUTH TELLURIDE. H.J.Goldsmid.
"Semiconductor Meeting Report", 127-31. See Abstr. 6165 (1957).

Measurements of the thermal and electrical conductivities of bismuth telluride have been made in the range of temperature 150°K to 300°K. The ratio of the electronic component of the thermal conductivity to the electrical conductivity is greater for specimens in which the charge carriers are intrinsically excited than for specimens in which the carriers arise from an impurity concentration. This can be explained if the transfer of ionization energy down a temperature gradient is taken into account. A.

537.311.33

7901. RECOMBINATION IN InSb.
T.S.Moss, T.Hawkins and S.D.Smith.
"Semiconductor Meeting Report", 133-6. See Abstr. 6165 (1957).

Recombination radiation from InSb has been detected and its spectral distribution measured. From the integrated value of the total radiation it is estimated that about 12% of the recombinations are radiative. Detailed measurements of the absorption spectrum on very thin specimens have enabled an accurate calculation of the radiation lifetime to be made. The value obtained is 0.7-0.9 μsec depending on the value of refractive index used. This is little more than some experimental values, again confirming the high proportion of radiative recombinations in this material. Some possible consequences of recombination radiation are indicated. A.

537.311.33 : 537.312.5

7902. PHOTO EFFECTS IN INDIUM ANTIMONIDE. D.W.Goodwin.
"Semiconductor Meeting Report", 137-45. See Abstr. 6165 (1957).

Methods are given for the determination of electron and hole mobilities, carrier lifetime and surface recombination velocity from photoeffects assuming a knowledge of the intrinsic carrier concentration at the required temperature and the number of extrinsic carriers at 90°K. The variation of mobilities and carrier lifetime in p-type InSb at room temperature is given as a function of hole concentration together with the variation of these parameters with temperature for specimens intrinsic at room temperature. For every photon absorbed an electron–hole pair is produced. A.

537.311.33 : 539.152.2

7903. NUCLEAR MAGNETIC RESONANCE IN INDIUM ANTIMONIDE. E.H.Rhoderick.
"Semiconductor Meeting Report", 147-53. See Abstr. 6165 (1957).

A study of the size and shape of the In^{115} resonance in InSb shows that it is sensitive to the degree of cold-working of the crystal and to the presence of Te atoms. Both these effects are ascribed to quadrupole coupling, the second suggesting the presence of highly mobile charge centres. Accurate measurements of the frequency of resonance in degenerate n-type InSb with 10^{19} carriers cm^{-3} revealed no Knight shift within the experimental error of 2 parts in 10^4. A.

537.311.33 : 537.312.5

7904. PHOTOELECTRIC MEASUREMENT OF THE INTERNAL ELECTRIC FIELD IN INHOMOGENEOUS SEMICONDUCTORS. H.Frank.
Czech. J. Phys., Vol. 6, No. 5, 433-52 (Oct., 1956).

An inhomogeneous distribution of donors or acceptors in a semiconductor produces an internal electric field, so that photoelectrons and photoholes migrate to opposite ends of the crystal. The effect has been used in this paper to study photoconductive properties by a null method. Information about the departures from homogeneity has been obtained, and comparison has been made with theory. P.T.Landsberg

537.311.33

7905. LITHOGRAPHIC STONE AND THE JOHNSEN-RAHBECK EFFECT. O.Benda.
Elektrotech. Obzor, Vol. 44, No. 3, 109-18 (1955). In Czech.

Experimental investigation of lithographic stone (96.5% $CaCO_3$, 1.67% Al_2O_3, 1.04% Si, 0.42% $MgCO_3$, 0.07% Fe_2O_3 and 0.3% impurities) has shown that the material behaves like a semiconductor. CO_3^- ions and the ions of the other constituents are the predominant carriers with a reduced role of type "n" electron carriers. Ca^{++} ions do not contribute to the conduction process. The reduced conductivity of the surface is traced to a film of reduced humidity caused by the capillarity of the material and also by air cushions between the surface and the experimental electrodes. The Johnsen–Rahbeck effect is demonstrated by an experiment and a suitable theory developed. Additional data show the Johnsen–Rahbeck effect at the interface of two semiconductors. E.Erdélyi

537.311.33

7906. IONIC CONDUCTIVITY OF ANODIC FILMS AT HIGH FIELD STRENGTHS: TRANSIENT BEHAVIOR. D.A.Vermilyea.
J. Electrochem. Soc., Vol. 104, No. 7, 427-33 (July, 1957).

Studies of the changes in ionic conductivity of anodic Ta_2O_5 films following rapid changes of applied voltage or following a heat treatment of the film have shown that the activation energy and activation distance for ionic motion vary with changes in electric field and temperature. A consideration of these results along with other information obtained from the corrosion behavior of the films and from X-ray diffraction by the films shows that a mechanism proposed earlier to account for ionic conduction in these films requires modification. It is suggested that a change of the applied field changes not only the number of conducting ions, as proposed earlier, but also changes the average local configuration in the glass-like film and, hence, changes the mobility of the ions as well. Transient behaviour similar to that shown by the Ta_2O_5 films is also shown by anodic films of Al_2O_3 and Nb_2O_5, but not by anodic ZrO_2. A.

537.311.33

7907. FIELD DEPENDENCE OF MOBILITY IN SEMICONDUCTORS. B.V.Paranjape.
Proc. Phys. Soc. B, Vol. 70, Pt 6, 628-9 (June, 1957).

If the lattice temperature (T) is below the Debye temperature, the mobility in non-polar semiconductors is proportional to $F^{-0.8}$ for fields (F) in excess of kT/msb (k = Boltzmann's constant, m = effective mass of carriers, s = velocity of sound, b = mobility for vanishing fields). R.Stratton

537.311.33

7908. ON THE MEASUREMENT OF LIFETIME, DIFFUSION COEFFICIENT AND SURFACE RECOMBINATION VELOCITY OF MINORITY CURRENT CARRIERS IN THIN SEMICONDUCTING SPECIMENS. O.V.Sorokin.
Zh. tekh. Fiz., Vol. 26, No. 11, 2473-9 (1956). In Russian.

The continuity equations are solved for a thin, flat specimen over which a light spot is swept at a constant velocity. It is shown how an experimental determination of minority carrier distribution in this situation can be used to calculate the minority carrier lifetime, diffusion coefficient and recombination velocities on the upper and lower surfaces. J.B.Arthur

537.311.33

7909. THE INFLUENCE OF THE APPLIED ELECTROSTATIC FIELD ON THE RATE OF SURFACE RECOMBINATION IN GERMANIUM. V.P.Zhuze, G.E.Pikus and O.V.Sorokin.
Zh. tekh. Fiz., Vol. 27, No. 1, 23-9 (1957). In Russian.

Apparatus is described for measuring the surface rate of recombination (s.r.r.) by methods due to Sorokin (Abstr. 4333/1957 and preceding abstract). The s.r.r. of 30 ohm.cm Ge single crystals is practically independent of the applied field. Graphs give the variation of the s.r.r. with concentration of induced charge carriers for Ge after various etching treatments and are compared with results

of Henisch and Reynolds (Abstr. 7048/1955). A model is proposed for the energy level scheme at the surface of a Ge single crystal. A.F.Brown

537.311.33 : 538.66

7910. THE NERNST–ETTINGSHAUSEN EFFECT IN STRONG MAGNETIC FIELDS. I.M.Tsidil'kovskiĭ.
Zh. tekh. Fiz., Vol. 27, No. 1, 12-22 (1957). In Russian.

The transverse Nernst–Ettingshausen (N–E) effect in HgSe was measured as function of temperature (120-440°K) and field (0-10^4 oersted). Results agree with theory. A simple method is described for calculating the mobility of current carriers from the measured values of the maxima of the N–E fields, E(H) and E(T), where H = magnetic field, T = temperature. Mobilities and their temperature dependence thus calculated agree well with values calculated from the Hall effect but are more reliable at medium field strengths. Further experiments on the longitudinal–transverse and longitudinal N–E effects also give results in accord with theory. A.F.Brown

537.311.33

7911. THE INFLUENCE OF RECOMBINATION PROCESSES ON GALVANOMAGNETIC EFFECTS. S.A.Poltinnikov and L.S.Stil'bans.
Zh. tekh. Fiz., Vol. 27, No. 1, 30-4 (1957). In Russian.

If the opposite faces of a strip of semiconducting material have different surface rates of recombination, then the change of resistivity in a magnetic field will differ when the field is reversed. Results on 27 ohm.cm Ge in fields up to 6000 oersted are given in graphs and agree with theory. The method and apparatus described give a simple method of measuring the two differing surface rates of recombination. A.F.Brown

537.311.33 : 536.424.1

7912. ON THE NATURE OF AMORPHOUS ANTIMONY.
G.A.Kurov and Z.G.Pinsker.
Kristallografiya, Vol. 1, No. 4, 407-9 (1956). In Russian.

The electrical properties of thin vacuum-deposited antimony films were found to change suddenly with structural transitions as determined by electron diffraction. It is concluded that the changes correspond with a phase transition from metastable amorphous antimony to a crystalline form. R.F.S.Hearmon

537.311.33 : 538.632

7913. ON THE HALL EFFECT IN BISMUTH AT LOW TEMPERATURE. H.Hasegawa, S.Nakano and N.Hashitsume.
J. Phys. Soc. Japan, Vol. 12, No. 1, 104 (Jan., 1957).

A preliminary account is given of a theory of the field dependence of the non-oscillatory part of the Hall effect. It is claimed that when the circular frequency of the charge carriers is very much greater than the collision frequency the difference between the number of electrons and holes can give rise to the observed variation (Abstr. 2000/1955). D.J.Oliver

537.311.33

7914. ELECTRICAL CONDUCTIVITY MEASUREMENTS ON CUPROUS HALIDES. J.B.Wagner and C.Wagner.
J. chem. Phys., Vol. 26, No. 6, 1597-601 (June, 1957).

The total electrical conductivity and the electron hole conductivity in solid CuCl, CuBr, and CuI between 250 and 450°C have been determined with help of a.c. measurements on samples between copper electrodes and d.c. polarization measurements on the cell: Cu/cuprous halide/graphite. A.

537.311.33

7915. INVESTIGATIONS ON CUPROUS SULFIDE.
J.B.Wagner and C.Wagner.
J. chem. Phys., Vol. 26, No. 6, 1602-6 (June, 1957).

The activity of copper in cuprous sulphide as a function of the copper-to-sulphur ratio has been determined with the help of coulometric titrations. The homogeneity range of cuprous sulphide at 400°C extends from a copper-to-sulphur ratio of 1.9996 ± 0.0002 for samples coexisting with metallic copper to a ratio of less than 1.93 for samples coexisting with digenite ($Cu_{1.8}S$). The ratio of the effective mass of electron holes to that of the free electron has been found to be 7 ± 2 at 435°C. Preliminary conductivity measurements suggest a considerable increase of the mobility of electron holes with an increasing copper deficit of the samples presumably due to fewer collisions of electron holes with excess electrons. A.

537.311.33

7916. INVESTIGATIONS ON CUPROUS SELENIDE AND COPPER TELLURIDES. G.Lorenz and C.Wagner.
J. chem. Phys., Vol. 26, No. 6, 1607-8 (June, 1957).

The activity of copper in cuprous selenide and various phases of the system copper–tellurium as a function of the metal-to-non-metal ratio has been determined with the help of coulometric titrations. At 400°C the homogeneity range of cuprous selenide extends from a Cu/Se ratio of 1.9975 ± 0.001 to a value lower than 1.86. Homogeneous phases of the system Cu–Te have been found between Cu/Te ratios equal to about 2 to 1.92, 1.43 to 1.39, and 1.32 to 1.30. A

537.311.3

7917. ELECTRICAL PROPERTIES OF GeTe.
Y.Moriguchi and Y.Koga.
J. Phys. Soc. Japan, Vol. 12, No. 1, 100 (Jan., 1957).

Curves of thermoelectric power Q, resistivity ρ and Hall coefficient R are given for polycrystalline and zone-melted single-crystal specimens over the range 100-700°K. The signs of Q and R are positive and the temperature coefficient of ρ is positive throughout the temperature range. The carrier density is 10^{20} – 10^{21} cm^{-3} for both types of specimen. F.F.Robert

537.311.33 : 539.23

7918. SOME PECULIARITIES OF THE ELECTRICAL PROPERTIES OF FILMS OF HgSe–HgTe.
O.D.Elpat'evskaya and A.R.Regel'.
Zh. tekh. Fiz., Vol. 27, No. 1, 45-50 (1957). In Russian.

Films of xHgSe(1–x)HgTe (x = 0.4, 0.5, 0.6) prepared by vacuum evaporation are very stable: the properties change little on exposure to air or water vapour. Depending on the temperature of the substrate and the rate of deposition, films may be transparent (T) or non-transparent (NT). The T films had smaller crystallite size than NT and probably had amorphous regions. The electrical properties of NT films approximated to those of specimens cast from the melt but the concentration of charge carriers and their mobility were both several times less than in cast samples. The mobility in T films was about 10 times less than in NT as would be expected if the T films were almost amorphous. A.F.Brow

537.311.33 : 537.32

7919. EQUILIBRIUM AND NON-EQUILIBRIUM PROPERTIES OF POLYCRYSTALLINE SELENIUM. P.T.Kozyrev.
Zh. tekh. Fiz., Vol. 27, No. 1, 35-44 (1957). In Russian.

The temperature dependence of the equilibrium concentration of holes (n_∞) in Se was derived from measurements of thermal e.m.f. Results agree with Henkels (Abstr. 287/1952). For specimens with low mobility of charge carriers, the equilibrium electrical conductivity (σ_∞) increased with temperature (T) to a maximum at about 140°C then fell. For specimens with high mobility, σ_∞ fell monotonically with increase of T in a manner similar to n_∞. Results are discussed in relation to the suggestion that the grains in polycrystalline Se are separated by regions (possibly amorphous) of high resistivity. A.F.Brow

537.311.33 : 536

ELECTRICAL PROPERTIES OF WO_3. See Abstr. 7817

537.311.3

7920. ON THE RECTIFICATION EFFECT OF Se–CdSe AND Se–HgSe CONTACTS WITH ARTIFICIAL BARRIER LAYERS. I.Kasabov.
C.R. Acad. Bulg. Sci., Vol. 8, No. 1, 17-20 (Jan.-March, 1955). In Russian.

Rectifiers were made by successive evaporation (in vacuo) of Se, quartz and CdSe or HgSe, Se being p-type and CdSe (or HgSe) n-type. In some samples the intermediate layer consisted not of quartz but of chemically deposited shellac. In all instances, the back voltage and rectification ratio were greater than for a corresponding rectifier without a barrier layer. J.B.Arth

537.311.33 : 621.314.7 : 621.314.

7921. THE INFLUENCE OF THE SURFACE ON THE ELECTRICAL PROPERTIES OF RECTIFIERS AND TRANSISTORS. W.Schultz.
Nachrichtentech. Fachber. (NTF), Vol. 5, 3-9 (1956). In German.

On the basis of Brattain–Bardeen (Abstr. 1637/1953) model for the adsorption of foreign molecules and the formation of surface layers on semiconductors, the three properties: work function, surface conductivity and surface recombination, are considered here and the influence of these surface properties on the technical behaviour of rectifiers and transistors are discussed for typical limiting cases. M.R.Hopki

537.3

7922. THE EFFECT OF PRESSURE ON THE ELECTRICAL RESISTANCE OF RUBIDIUM. J.S.Dugdale and J.A.Hulbert.
Canad. J. Phys., Vol. 35, No. 6, 720-9 (June, 1957).

By using helium in both the solid and the fluid state as a

pressure-transmitting medium, it has been possible to measure the resistance of rubidium over the temperature range from 2°K to room temperature at pressures up to 2500 atm. In particular the effect of pressure on the transition at ~200°K, on the low temperature ideal resistivity, and on the residual resistivity was examined. A.

537.312 : 541.183.5

7923. VARIATION OF RESISTANCE OF THIN, FREELY SUPPORTED COPPER AND GOLD FILMS DUE TO THE SURROUNDING GAS. S.Tunakan.
Naturwissenschaften, Vol. 44, No. 1, 6 (1957). In German.

Work previously described (Abstr. 4320/1957) on the variation of resistance of thin Ag films, attributed to adsorption of H_2 and O_2, has now been extended to include an investigation of Cu films 255 mμ (1000 atoms) thick and Au films 182 mμ (700 atoms) thick. No measurable effect was observed with He. M.R.Hopkins

537.312.5

7924. PHOTOCONDUCTIVITY CONFERENCE.
Edited by R.G.Breckenridge, B.R.Russell and E.E.Hahn.
New York: John Wiley; London: Chapman & Hall (1957) 653 pp.

This symposium includes 30 papers, and the discussions read at a Conference on Photoconductivity held in 1954 under the sponsorship of the Office of Naval Research, the University of Pennsylvania, and the Radio Corporation of America. The symposium covers most phases of the subject in sufficient detail to serve both as an introduction to the field and as a monograph for advanced workers. The titles are:

PHENOMENOLOGICAL THEORY OF PHOTOCONDUCTIVITY.
Performance of Photoconductors, A.Rose; The Relation between Lifetime, Limit of Sensitivity, and Information Rate in Photoconductors, R.L.Petritz.

PHOTON ABSORPTION PROCESS.
Theoretical Ideas Pertaining to Traps or Centres, C.Herring; The Influence of Lattice Vibrations on Electronic Transitions in Solids, M.Lax; Indirect Transitions from the Valence to the Conduction Bands, J.Bardeen and F.J.Blatt and L.H.Hall; Absorption Near the Edge in Insulators, D.L.Dexter; Infrared Absorption and Energy-Band Structure of Germanium and Silicon, H.Y.Fan, M.L.Shepherd and W.Spitzer; Note on the Statistical Mechanics of Semiconductor Crystals with Electron-Vibration Coupling, H.James.

ELECTRON PROCESSES.
Electron Processes in Photoconductors, E.S.Rittner; The Ranges of Charge Carriers in Photoconductors, F.Stöckmann; The Role of Chemisorption in Surface Trapping, P.H.Miller,Jr; Interfacial Photoeffects in Germanium at Room Temperature, C.G.B.Garrett and W.H.Brattain; The Photoelectromagnetic Effect, L.Pincherle; The Trapping of Minority Carriers in Silicon, J.R.Haynes and J.A.Hornbeck.

PHOTOCONDUCTING MATERIALS.
Optical and Photoconductive Properties of Silicon and Germanium, E.Burstein, G.Picus and N.Sclar; Photoconductivity and Photovoltaic Effect in Intermetallic Compounds, H.P.R.Frederikse and R.F.Blunt; Absorption and Photoconductivity in Indium and Antimonide, T.S.Moss; Photoexcitation in Ionic Crystals, J.A.Krumhansl; The Electrical and Optical Properties of Lead Sulphide and Allied Semiconductors, R.P.Chasmar; Photoconductivity of PbS, G.W.Mahlman, W.B.Nottingham and J.C. Slater; Electrical and Optical Properties of Zinc Oxide, E.Mollwo.

CURRENT TOPICS.
Photoeffects in InSb, S.W.Kurnick and R.N.Zitter; Gold-Doped Germanium, W.C.Dunlap,Jr; Impurity Photoconduction in Germanium, G.A.Morton, E.E.Hahn and M.L.Schultz; Carrier Lifetime in Tellurium, D.Redfield; Superlinear Photoconductivity, R.H.Bube; Fine-Spot Scanning of Lead Sulfide Films, D.Dutton; The Electrical and Optical Properties of Lead Films, H.Levinstein; The Chemical and Physical Properties of Lead Sulfide Single Crystals, W.W.Scanlon, R.F.Brebrick and R.L.Petritz; Hall Effect and Resistivity Measurements on Photoconductive Lead Sulfide Films under Illumination, J.F.Woods.

537.312.5

7925. BARRIER-LAYER-FREE PHOTOVOLTAIC ELEMENTS OF EVAPORATED CdS.
G.Nadzhakov, B.Andreĭchin, C.Balabanov and Yu.Stanislavova.
C.R. Acad. Bulg. Sci., Vol. 9, No. 2, 1-4 (April-June, 1956).
In German.

CdS layers were prepared on a glass substrate by evaporating a Cd layer on a S layer and then heating in air for 10-20 minutes to 400-460°C. Ohmic contacts were made with Al and Au electrodes. Under a light intensity of 2×10^4 lux, a photo-e.m.f. of 0.2-0.3 V and a current of $10^{-7} - 10^{-8}$ A were obtained. The photo-e.m.f. is due to the contact potential difference between the electrodes. A drop in the e.m.f. to about half its original value during the first few days is caused by diffusion of the sulphide. J.Franks

537.312.5

7926. PHOTOCONDUCTIVITY OF THIN FILMS OF ARSENIC TRISULFIDE. H.Schlosser.
J. appl. Phys., Vol. 28, No. 4, 512-13 (April, 1957).

Measurements were made at room temperature on evaporated films of As_2S_3 1-10μ thick. At low light intensities (I) the photocurrent $C \propto I^{1.70}$, at high intensities $C \propto I^{0.73}$. The absorption edge is at 5100 A, the maximum sensitivity at 4000 A. J.Franks

537.312.5 : 538.561 : 621.383.27

ON GENERATION IN PHOTOELEMENTS AND PHOTOMULTIPLIERS. See Abstr. 7241

537.312.5 : 535.371

EFFECT OF SURFACE CONDITION ON THE SURFACE PHOTOCONDUCTIVITY OF ANTHRACENE. See Abstr. 7773

537.312.5 : 537.311.33

PHOTO EFFECTS IN INDIUM ANTIMONIDE. See Abstr. 7902

537.312.62 : 536.631

7927. THEORY OF THE SPECIFIC HEAT OF SUPERCONDUCTORS BASED ON AN ENERGY-GAP MODEL. N.Bernardes.
Phys. Rev., Vol. 107, No. 2, 354-7 (July 15, 1957).

A two-fluid model of a superconductor is proposed, based on an approximation in which one-electron states within a range of the order of kT_c from the Fermi level are forbidden. It is assumed that the corresponding energy gap decreases with temperature and vanishes at the transition temperature; such an assumption is necessary in order to have a second-order transition. Assumptions are also made concerning the behaviour of the electrons in a superconductor, and general formulae are developed involving two parameters which describe the approximate shape of the gap. Detailed calculations are presented for two different sets of values of these parameters and the results for the electronic specific heat predict the general exponential dependence on temperature which agrees with recent experimental data for Sn and V. A.

537.312.62

7928. THEORY OF CYCLOTRON RESONANCE IN METALS. V.Heine.
Phys. Rev., Vol. 107, No. 2, 431-7 (July 15, 1957).

Azbel' and Kaner have shown that a cyclotron resonance phenomenon is possible in a metal under extreme anomalous skin-effect conditions when the magnetic field is parallel to the metal surface. Here the correct form of the surface impedance is deduced in a more simple way by using the "ineffectiveness concept" of Pippard. An approximate criterion is also established for how nearly parallel to the surface the magnetic field must be. When the oscillating electric field is not parallel to the constant magnetic field, it produces a polarization of the charge distribution in the metal, and it is shown that this effect does not destroy the resonance in contrast to the situation in semiconductors. A.

537.312.62 : 537.533.75

ENERGY LOSS OF A CHARGED PARTICLE TRAVERSING SUPERCONDUCTORS. See Abstr. 7156

537.312.7

7929. ON THE DEPENDENCE ON THE FIELD STRENGTH OF THE ELECTRICAL CONDUCTIVITY OF SELENIUM SINGLE CRYSTALS. H.Gobrecht and H.Hamisch.
Z. Phys., Vol. 148, No. 2, 218-32 (1957). In German.

Application of a strong a.c. field across hexagonal Se single crystals caused a rapidly rising and decaying increase in dark conductivity (field excitation), superposed on a decrease in dark conductivity with slow rise and decay times (field quenching). Similar effects were obtained with strong d.c. fields. With a crystal previously exposed to white light, a high field increased the decay rate of the photoelectric conductivity. The dependence of conductivity on field strength may be due to an effect on the concentration of charge carriers. J.Franks

537.312.8 : 538.632

7930. PREPARATION OF PURE LITHIUM SAMPLES FOR ELECTRICAL MEASUREMENTS. W.B.Pearson.
Canad. J. Phys., Vol. 35, No. 1, 124 (Jan., 1957).

Description of preparation of pure lithium samples by running the molten metal into soft-glass moulds. The samples were required for Hall effect measurements. W.Good

537.323 : 537.311.31 : 539.4.016

7931. THE THERMOELECTRIC POWER OF COPPER, SILVER AND GOLD AFTER COLDWORKING. D.J.v.Ooijen.
University of Delft Dissertation, 126 pp. (1956). In English, with summary (3 pp.) in Dutch.

The thermoelectric power of Cu, Ag, and Au wires which had been cold-worked by drawing at room temperature was measured against undeformed wires of the same material from helium up to room temperature. The increase in resistivity before any recovery process had taken place was also measured. The change in the differential thermoelectric power and of the resistivity was then followed through the recovery process brought about by slow annealing at various temperatures up to 100°C. The theory of the thermoelectric effects appropriate to the experiments is extended to cover the experimental conditions, and two independent electron scattering mechanisms are considered. The experimental results are most satisfactorily interpreted in terms of formulae due to Friedel (Abstr. 1343/1954). C.A.Hogarth

537.323 : 538.63

7932. MAGNETIC FIELD DEPENDENCE OF THE SEEBECK EFFECT IN GERMANIUM. M.C.Steele.
Phys. Rev., Vol. 107, No. 1, 81-3 (July 1, 1957).

The thermoelectric power (Seebeck effect) of n-type Ge single crystals has been measured as a function of magnetic field at four temperatures ranging from 78°K to 278°K. At all temperatures the magnitude of the thermoelectric power increased with magnetic field. Such behaviour is shown to be consistent with a simplified model of a semiconductor. It was also observed that to within $\frac{1}{2}$% the thermal conductivity of Ge did not change as the magnetic field increased from zero to 11 500 Oe. A.

537.324

7933. THE TECHNICAL EVALUATION OF THERMOELECTRIC EFFECTS (PARTICULARLY IN ZINC–ANTIMONY ALLOYS). H.J.Leyers.
Dissert. E.T.H. Zürich, No. 2557, 101 pp. (1956). In German.

The efficiency of the thermoelectric element, when used as an electrical generator, a refrigerator, or a heat pump, is treated mathematically. The results of some experimental studies of Zn–Sb alloys are given. P.M.Davidson

ELECTRIC DISCHARGES 537.52

537.521.6

7934. RANDOMNESS OF MICROWAVE GAS BREAKDOWN VOLTAGE. K.Mitani and H.Kubo.
J. Phys. Soc. Japan, Vol. 12, No. 4, 437-8 (April, 1957).

A brief account of experimental determination of microwave breakdown strength, apparently of air. Results are exhibited graphically and attention is drawn to the effect of irradiation of the discharge gap with γ-rays from Ra. The pressure range is from about 0-35 mm Hg. J.D.Craggs

537.521.6 : 541.67

7935. ELECTRIC STRENGTH OF UNSATURATED HYDROCARBON GASES. R.W.Crowe and J.C Devins.
Nature (London), Vol. 179, 976-7 (May 11, 1957).

For olefins, as for saturated hydrocarbons (Abstr. 2266/1957) the addition of a CH_2 group produces a constant increment in the scattering section, θ. The double-bond contributes substantially to the scattering cross-section due to decreased shielding effect of C–H bonds, and the larger spatial configuration of the π-electron orbitals associated with the C–C bonds. θ depends little on branching or the position of the double bond. J.H.Mason

537.521.6 : 621.3.015.5

7936. THE MECHANISM OF UNIFORM FIELD BREAKDOWN IN HYDROGEN. A.Wilkes.
Rep. Brit. Elect. Res. Assoc., Rep. L/T335, 4 pp. (1955).

Measurements with the object of checking the streamer theory over a wide range of values of pd, the product of gas pressure and gap length, have been continued. Earlier results showed that the Townsend theory of breakdown involving: (i) a primary ionization process in the gas denoted by the Townsend coefficient α, and (ii) a secondary process, here denoted by γ, probably taking place at the cathode, is adequate to explain the initiation of breakdown in both air and nitrogen up to a value of pd of about 1000 (cm) x (mm H Results in air lend support to this view, and in this report the resu of similar experiments in hydrogen are given. A

537.521

7937. THE EMISSION OF IONIZING RADIATION DURING A SPARK DISCHARGE. W.A.Prowse and G.R.Bainbridge.
Canad. J. Phys., Vol. 35, No. 3, 324-31 (March, 1957).

A high-voltage pulse lasting 0.35 microsecond is applied to a pair of delay lines, so that two pulses can be picked up from adjus able points of connection on the lines. One is applied to an irradia ing gap and the other to a longer test gap, the gaps being so arran that only mid-gap irradiation occurs. The sparking probability, P of the test gap is used to indicate the presence of ionizing radiatio Variations of P with the time interval between the two pulses are recorded. They indicate that ionizing radiation is emitted in repe ed short flashes. Photographic observations support this view. A

537.52

7938. PINCH EFFECT. L.C.Burkhardt, R.E.Dunaway, J.W.Mather, J.A.Phillips, G.A.Sawyer, T.F.Stratton, E.J.Stovall, Jr and J.L.Tuck.
J. appl. Phys., Vol. 28, No. 5, 519-21 (May, 1957).

Some early studies of the Pinch Effect, made with a view to its application to the problem of developing a thermonuclear reaction are here presented, together with experimental arrangements for producing pinched discharges in toroidal and straight discharge tubes. Dynamical properties of the pinch and its instabilities are demonstrated, and the possibility of stabilizing the latter is mentio ed. A

537.5

7939. INFLUENCE OF ILLUMINATION FROM OUTSIDE ON AN A–Hg DISCHARGE TUBE. T.Nakaya.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1264-84 (Dec., 1956).

It is shown that a faint illumination by ultraviolet or visible light thrown on the discharge space of a low-pressure A–Hg dis- charge tube increases the starting potential to a remarkable exte This effect only takes place when there exist relatively high wall-tem ature of 40-90° C (i.e. high density of Hg atoms) and relatively hig pressure of argon gas (a few mm Hg). When the intensity of illum nation exceeds a certain value, the starting potential shows a som what saturated constant voltage. This effect is sensitive to radiat ions of any wavelength ranging from ultraviolet to visible light. A addition of a small quantity of H_2 gas suppresses this effect. The part of the tube that is sensitive to radiation is on the anode side. According to the hypothesis of the author, under such condition th both the pressure of A gas and the density of Hg atoms are adequ there seems to exist a region where metastable molecules of mer cury are indispensable for starting a glow discharge as a princip source of ions. On this assumption most of the experimental res can be explained fairly well.

537.52

7940. MINIMUM SPARK BREAKDOWN AND GLOW VOLTAGES W.A.Gambling and F.W.Crawford.
Canad. J. Phys., Vol. 35, No. 5, 562-9 (May, 1957).

Measurements of the spark breakdown voltage between carbo electrodes in hydrogen, argon, nitrogen, and air are given for ranges of the product p (mm Hg) x d (cm) between 0.1 and 1000 mm Hg cm. The results show that in each gas Paschen's La is obeyed for pd > 10 mm Hg cm. For pd < 10 mm Hg cm deviat from Paschen's Law were observed at the longer gap lengths. Th minimum spark breakdown voltage, V_{sm}, occurred near pd = 1 mm Hg cm. The normal cathode-fall voltage, V_{cn}, was also measured, and was found to be less than V_{sm} in hydrogen, argon air, and greater than V_{sm} in nitrogen. A theoretical analysis is made which predicts the relationship $V_{cn} = 1.110\ V_{sm}$ and the reasons why this condition is seldom found in practice are discus

537.52

7941. SPLITTING OF THE CATHODE SPOT OF AN ELECTRI ARC. I.G.Kesaev.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 1, 71-4 (1957). In Russian.

Observations made on the cathode spot of a low-pressure

mercury arc show that the spot is in a process of continuous division. Photographs are given showing the track of a spot in its regular motion in a magnetic field tangential to the cathode, also a list of observed regularities of behaviour in the branching of the light band. Magnetic field seems to have a considerable stabilizing effect on the spot. The frequency of division of the spot is of the order of 10^5 sec $^{-1}$. C.R.S.Manders

537.525.8

7942. OSCILLATIONS IN DIRECT CURRENT GLOW DISCHARGES. A.M.Pilon.
Phys. Rev., Vol. 107, No. 1, 25-7 (July 1, 1957).

A d.c. discharge can behave as an a.c. current generator; under certain conditions, stable oscillations appear with the same period in the current and in the light emitted by the positive column even if it seems steady to the eye. The current oscillations have been analysed for their harmonic content. The various waveforms of the light oscillations observed along the positive column can be attributed to the fact that the component oscillations of different frequencies travel with different speeds. A.

537.525.92

7943. ON THE SPACE CHARGE AFFECTED BY THE MAGNETIC FIELD. II. Y.Yasuoka.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1292-5 (Dec., 1956).

For previous part see Abstr. 1277 (1956). Gives a more advanced treatment, taking into account the effect of the magnetic field on the scattered electrons. As a result, values have been obtained which are much nearer to the experimental values and the agreement is considered satisfactory. A.

537.527

7944. CONTROLLED CORPUSCLE BEAM DISCHARGES. A PROPOSED NEW METHOD FOR ATTAINING HIGH TEMPERATURES AND ENERGY DENSITIES. B.W.Schumacher.
Canad. J. Phys., Vol. 35, No. 2, 239-40 (Feb., 1957).

A new scheme for the production of a high temperature plasma is proposed. A very intense beam of charged corpuscles would be shot into a high density gas, e.g., 20 atmospheres pressure. The region of gas which would be heated would be far from any walls. The particles are to be produced and accelerated in a vacuum and passed into the gas by a system of dynamic pressure stages. The possibility of obtaining a fission reaction, resulting in a series of micro-explosions with the far off walls of the reaction chamber acting as heat exchangers, is considered. D.R.Chick

X-RAYS 537.531

537.531

7945. CHARACTERISTIC X-RAYS PRODUCED BY PROTONS OF 0.2 TO 1.6 MeV ENERGY. J.M.Hansteen and S.Messelt.
Nuclear Physics, Vol. 2, No. 5, 526-32 (Jan., 1957).

The total thick target yield of X-rays excited by 0.2 to 1.6 MeV protons has been measured for Cu and Mo using a NaI scintillation spectrometer. The corresponding cross-sections for K-shell ionization have been determined. For the lowest proton energies these values are smaller than the theoretical ones by a factor of 10-13, the ratio between theory and experiment decreasing to 1 for the highest energies. A.

537.531 : 535.34

7946. SOFT X-RAY ABSORPTION BY THIN FILMS OF CHROMIUM. B.K.Agarwal and M.P.Givens.
Phys. Rev., Vol. 107, No. 1, 62-4 (July 1, 1957).

The absorption of soft X-rays by chromium has been measured in the spectral region between 250 A and 300 A. The observed absorption band is interpreted as a combination of M_3 and M_2 bands in the ratio of 3 : 2 and separated by 1.5 eV. A.

537.531 : 535.43

7947. SMALL-ANGLE X-RAY SCATTERING FROM THE LOW CARBON PARAFFINS. J.W.Buttrey.
J. chem. Phys., Vol. 26, No. 6, 1378-81 (June, 1957).

The small angle X-ray scattering patterns from the four lowest carbon normal paraffins: methane, ethane, propane, and butane have been determined near the critical temperature using a single crystal spectrometer. Monochromatization was obtained with a rocksalt crystal reflecting the Kα lines of copper, and detection was with a Geiger counter. The data have been analysed to show a qualitative confirmation of the well-known Zernike—Prins relation between the X-ray intensity scattered at small angles and the isothermal compressibility. A study of a "particle size" corresponding to the size of regions of statistical density fluctuation near the critical temperature fails to show a detectable difference in the size of these regions for different thermodynamic conditions of the same hydrocarbon or for different hydrocarbons at roughly equivalent conditions, but indicates an increase in the number of such regions as the transition between liquid and vapour is approached from either the vapour or the liquid. A.

537.531 : 535.43 : 539.152.1

PHOTON SELF-ABSORPTION AND SCATTERING BY THE 15.1 MeV LEVEL IN C^{12}. See Abstr. 7297

CATHODE RAYS. POSITIVE RAYS

537.533/.534

537.533

7948. THE ELECTROMAGNETIC INTERACTION BETWEEN TWO CROSSING ELECTRON STREAMS. I. G.H.Joshi.
Chalmers Tekn. Högsk. Handl., No. 183, 29 pp. (1957).

The interaction between two infinitely extended velocity-modulated electron streams moving transversely to one another, has been studied in detail. It is shown that, in addition to space charge waves, there are electromagnetic waves which exhibit resonance phenomena when the stream drift velocity approaches the phase velocity of the wave in the direction of the drift. A.J.Egginton

537.533

7949. ELECTRON MODEL FIXED FIELD ALTERNATING GRADIENT ACCELERATOR. F.T.Cole, R.O.Haxby, L.W.Jones, C.H.Pruett and K.M.Terwilliger.
Rev. sci. Instrum., Vol. 28, No. 6, 403-20 (June, 1957).

A radial sector F.F.A.G. accelerator has been constructed and successfully operated. In this 8-sector accelerator electrons are betatron accelerated from 25 to 400 keV using both continuous and pulsed injection. The number of radial betatron oscillations per revolution may be varied from 2.3 to 3 and the number of vertical oscillations per revolution from 1 to 3. Calculations of these oscillation frequencies using various approximations are described and discussed. These frequencies have been measured statically with the unaccelerated beam and dynamically using an r.f. perturbing voltage on the accelerated beam. Results of these calculations and experiments are in satisfactory agreement. Effects of misalignments have been measured and are in close agreement with calculations presented. A survey has been made over a large area of the betatron oscillation stability region. The effects of the many resonances observed are in good qualitative agreement with theory. A.

537.533.2 : 548.5

FIELD EMISSION FROM MERCURY WHISKERS. See Abstr. 7485

537.533.2 : 535.37

INFLUENCE OF PRESSURE AND DISLOCATIONS ON THE ELECTRON EMISSION OF SODIUM CHLORIDE. See Abstr. 7764

537.533.2 : 537.312.5 : 537.311.33

WORK FUNCTION OF CLEANED Ge SURFACE. See Abstr. 7863

537.533.2 : 537.311.33

WORK FUNCTION CHANGES INDUCED BY LIGHT AND ELECTROSTATIC FIELDS. See Abstr. 7877

537.533.3 : 621.385.833

7950. ELECTRON GUNS OF HIGH PERVEANCE. R.Hechtel.
Arch. elekt. Übertragung, Vol. 10, No. 12, 535-40 (Dec., 1956). In German.

Efficient generation of high frequency radiation depends on the perveance P of the electron gun, and on the ratio R of cathode area to minimum beam cross-section. On Pierce's principles gun design for axially symmetrical beams will reach a perveance of 1 $\mu A/V^{3/2}$, but this may be increased by the modifications discussed. A design is shown with P = 5 $\mu A/V^{3/2}$ and R = 5, with curves for the observed variation of (1) P and (2) loss of current to the accelerating electrode v. accelerating potential, in each case for three different cathode temperatures. Two other gun designs for lower P but much higher R are briefly described. S.T.Henderson

537.533.35

7951. EXPERIMENTAL STUDY OF THE VELOCITY SPECTRUM OF ELECTRONS TRANSMITTED BY THE DIAPHRAGM OF AN ELECTRON EMISSION MICROSCOPE. F.Pradal and R.Simon.
C.R. Acad. Sci. (Paris), Vol. 244, No. 16, 2150-2 (April 15, 1957). In French.

A specimen is bombarded with ions and the velocity distribution of the secondary electrons is measured with a velocity spectrometer having a resolution of 1 volt in 20 000. It is found that the distribution of velocity is profoundly affected by the size of the limiting diaphragm of the objective lens. A.E.I. Research Laboratory

537.533.35 : 539.165.08

7952. HIGH-DISPERSION TWO-DIRECTIONAL-FOCUSING β-SPECTROMETERS. G.E.Lee-Whiting.
Canad. J. Phys., Vol. 35, No. 5, 570-5 (May, 1957).

Momentum spectra of charged particles are often analysed with the aid of magnetic focusing; in one type of spectrometer the particles move along a circular arc roughly perpendicular to the lines of force. It is shown that when the beam is turned through an angle of $\pi(n^2+1)^{1/2}$ radians in a suitably shaped magnetic field a two-directional focus is obtained. For this type of instrument the dispersion increases rapidly as n is increased, while the aberrations remain roughly constant. Even for values of n in the range 3 to 7 an enormous gain in "luminosity" and a useful increase in the permitted source width should be obtained. Although practical difficulties are introduced by the use of paths of more than one complete revolution, these should not be insuperable if the size of the apparatus is large enough relative to the size of the source, especially if an odd value of n is used. A.

537.533.7

7953. THE SPIN KINEMATICS FOR A CHARGED PARTICLE IN A UNIFORM MAGNETIC FIELD. M.Carrassi.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 955-60 (April, 1957).

The influence of a uniform magnetic field on the spin orientation of electrons in a beam is calculated according to the Dirac theory. It is shown that, when the field is perpendicular to the electron beam path, the spin orientation does not change with respect to the direction of propagation. The calculations are performed using the exact solution of the Dirac equation. A.

537.533.74 : 541.57

7954. INFLUENCE OF CHEMICAL BONDS ON ATOMIC SCATTERING OF ELECTRONS.
B.K.Vainshtein and B.F.Dvoryankin.
Kristallografiya, Vol. 1, No. 6, 626-30 (1956). In Russian.

The problem is discussed in terms of lithium and oxygen (ionized and un-ionized) and lithium oxide. R.F.S.Hearmon

537.533.74

7955. THEORY OF LOW-ENERGY ELECTRON SCATTERING BY POLAR MOLECULES. S.Altshuler.
Phys. Rev., Vol. 107, No. 1, 114-17 (July 1, 1957).

The total diffusion cross-section is calculated for low-energy impact of electrons upon polar molecules in an approximation which treats the molecules as fixed rotators. The amplitude is evaluated and the differential cross-section corresponding to fixed orientation of the molecule is then averaged over the Maxwell distribution. It is shown how this simple approach follows from an adiabatic approximation to the excitation amplitudes. The results show excellent agreement with available data. A.

537.533.74

7956. EXPERIMENTAL POSSIBILITY OF INVESTIGATING THE STRUCTURE OF THE ELECTRON. V.A.Petukhov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 379-80 (1957). In Russian.

A method is suggested for investigating the scattering of very high energy electrons on electrons. Ways are indicated to overcome the difficulties in obtaining beams of electrons of sufficiently high energy and density. Z.Krasucki

537.533.75

7957. DISSIPATION OF ENERGY BY 2.5-10 keV ELECTRONS IN Al_2O_3. J.R.Young.
J. appl. Phys., Vol. 28, No. 5, 524-5 (May, 1957).

Measurements have been made of the energy distribution of electrons penetrating thin samples of Al_2O_3. The observations were made using a 127° electrostatic analyser. These results allow a determination of the dissipation of electron energy with depth when 2.5-10 keV electrons strike Al_2O_3. Results obtained indicate that for a given bombarding energy the average energy loss per unit thickness dW/dx remains almost constant over the entire penetration depth. However, dW/dx decreases slowly as the bombarding electron energy increases. These observations are in general agreement with those made by Ehrenberg and Franks for 10-40 keV electrons striking phosphors. A.

537.533.79 : 539.11

7958. MEASUREMENT OF INTERNAL POTENTIAL BY ELECTRON INTERFERENCE. G.Möllenstedt and M.Keller.
Z. Phys., Vol. 148, No. 1, 34-7 (1957). In German.

A value of +24 volts was found for the internal potential of a carbon specimen by measurement of the interference between two coherent electron wave-trains passing through thin carbon foils of different thickness. Electrons of 55 kV energy were used, and the splitting was achieved by an electron-optical biprism employing a charged metallized quartz thread. The foil thicknesses were 40 and 160 A. B.Meltzer

537.533.8 : 535.376 : 621.385.832 : 621.315.61

7959. THE MOVEMENT OF THE SECOND CROSSOVER POTENTIAL OF INSULATORS. A.B.McFarlane.
Brit. J. appl. Phys., Vol. 8, No. 6, 248-52 (June, 1957).

The secondary emission coefficient δ of metals and insulators has hitherto been considered to be a definite function of primary electron energy eV_S. The curve relating δ to V_S has two positions, one at low potentials in the range 10 to 100 V, and the other from 1000 V upwards, at which δ is equal to unity, with a maximum value between them. These two positions are known as the first and second crossover potentials respectively. In a cathode-ray tube, the luminescent screen is an insulator, itself mounted on an insulating glass base. The curve relating δ to V_S then determines the highest potential to which the screen can be brought, this being at or near the second crossover. This effect is very pronounced and is well known in earlier cathode-ray tubes. It sets a quite definite limit to the luminance available and also to the high voltage which can usefully be applied to the tube. It has now been found that by suitable treatment of the screen, for example by settling it in a strong silicate solution or by applying a layer of magnesium oxide smoke to the bombarded surface, the second crossover may be made to vary rapidly with the electric field applied. In this way the second crossover can be made to follow closely the applied anode voltage, thus allowing the application of almost unlimited values to the tube with a consequent gain in luminance and performance. A.

537.533.

7960. ON THE THEORY OF THE SECONDARY EMISSION OF ELECTRONS. L.Eckertová and J.Vejvodová.
Czech. J. Phys., Vol. 6, No. 5, 525-7 (Oct., 1956). In Russian.

An expression is derived for the dependence of the coefficient of secondary emission on energy of primary electrons. The calculated coefficients agree well with experimental data. Z.Krasucki

537.533.

7961. SOME OBSERVATIONS ON TRANSMISSION SECONDARY EMISSION. J.R.Young.
J. appl. Phys., Vol. 28, No. 4, 512 (April, 1957).

Emission obtained with incident electron energies in the range 1 to 10 keV from Al_2O_3 + KCl and Al_2O_3 + KCl plus conducting or non-conducting gold and conducting Al layers is reported. Maximum yield is obtained with Al layer present. C.G.Morga

537.533.

7962. SECONDARY ELECTRON EMISSION OF SINGLE CRYSTALS OF MgO. N.R.Whetten and A.B.Laponsky.
J. appl. Phys., Vol. 28, No. 4, 515-16 (April, 1957).

Unusually high yields ~20-25, previously reported by Lye, are confirmed with gas-covered single crystals. C.G.Morga

537.533

7963. ON THE THEORY OF SECONDARY EMISSION OF META
J.L.H.Jonker.
Philips Res. Rep., Vol. 12, No. 3, 249-58 (June, 1957).

The angular distribution of the secondary emission of nickel i measured with small intervals of energy. The results permit a hypothesis about the mechanism of the emission, the energy distribution, and the scattering of secondary electrons inside the metal. An explanation is proposed for the cosine distribution of the emitt secondary electrons.

537.533.8 : 537.534

7964. POLARIZATION OF BREMSSTRAHLUNG FROM MONO-CRYSTALLINE TARGETS. H.Überall.
Phys. Rev., Vol. 107, No. 1, 223-7 (July 1, 1957).

It is shown that, owing to interference effects, the polarizatio

is considerably increased above its value when amorphous targets are used (by a factor of 1.5 for typical cases); moreover, the total emitted bremsstrahlung cone has an over-all net polarization with respect to the plane formed by the direction of incidence and the crystal axis. This latter fact provides a means of producing partially polarized radiation with an intensity sufficient for performing significant high-energy polarization experiments. The dependence on the emission angle of the interference radiation is also calculated. The influence of elastic scattering of electrons is estimated. A.

537.533.9

7965. ON SOME FEATURES OF THE VAVILOV–CHERENKOV RADIATION IN ANISOTROPIC MEDIA. V.E.Pafomov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 366-7 (1957). In Russian.

The motion of a charge down the optic axis of a uniaxial dielectric crystal is briefly considered. The sign of the group velocity of the radiation is discussed, and it is shown that the angle between a ray of the radiation and the direction of motion of the charge can be greater than 90°. S.Chomet

537.534 : 621.319.523

7966. A HIGH-FREQUENCY 500 KILOVOLT COCKCROFT–WALTON ACCELERATOR. P.Lorrain, R.Béique, P.Gilmore, P.E.Girard, A.Breton and P.Piché.
Canad. J. Phys., Vol. 35, No. 3, 299-312 (March, 1957).

The 500 kilovolt accelerator described is of the Cockcroft–Walton type and is operated at a frequency of 32 kc/s. It is pressurized for compactness. The circuit comprises 24 stages and is terminated by an inductive load which increases the output voltage by a factor of 1.5. The rectifier filaments are heated by utilizing the current flowing through the stray capacitances of the rectifiers. The circuit calculations are given and the design is described briefly. A.

537.534 : 536.62

7967. THE DESIGN OF CALORIMETERS FOR THE DETERMINATION OF ION BEAM INTENSITIES. E.R.Harrison.
J. sci. Instrum., Vol. 34, No. 6, 242-4 (June, 1957).

Calorimetric methods for determining the total particle flux of ion beams are discussed. Three types of calorimeter are described which, from experience gained with 25-50 mA, 10 keV and 0.2 mA mean, 500 keV proton beams, have proved suitable for this purpose. The sensitivity of the calorimeters can be either calculated from elementary theory, or obtained directly by a convenient method of calibration. A.

537.534.3

7968. ON THE THEORY OF THE 90° MASS SPECTROMETER. II. REAL MAGNETIC FIELD, TRAJECTORIES IN THE PLANE OF SYMMETRY. D.Charles.
Ann. Radioélect., Vol. 12, 62-77 (Jan., 1957). In French.

For Pt I see Abstr. 466 (1956). The influence of end-effects and non-uniformity of the analyser field on image formation is examined. It is concluded that end-effects lead to loss of symmetry which may be corrected by suitable displacement of the magnet. Increase of the field in the gap with radius affects symmetry, and the second-order aberration, α, becomes more serious; if the field is made to decrease with radius, α may be reduced by adjusting the position of the slits. Variation of field along the mean ion trajectory leads to a slight image displacement and α is not appreciably affected. The effects are illustrated by numerical examples. N.M.King

537.534.3

7969. A MASS SPECTROMETER WITH IMPROVED PROPERTIES FOR THE ANALYSIS OF HYDROGEN CONTAINING A LOW CONCENTRATION OF DEUTERIUM. D.D.Gvozdanović.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 7, 83-91 (March, 1957).

A mass spectrometer suitable for the measurement and comparison of isotope ratios of samples of hydrogen gas containing 0.003 mol%D to 1 mol%D is described. An ion source without magnetic field is used, thereby eliminating one factor which affects mass discrimination. Other factors which affect mass discrimination are taken into account, and direct measurements are made. Results of these measurements are in good agreement (3%) with results obtained by other methods. Samples containing 0.015 mol%D can be be compared with a precision of 0.0001 mol%D. A.

537.534.74

7970. ELASTIC PROTON–PROTON SCATTERING AT 660 MeV. N.P.Bogachev and I.K.Vzorov.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 931-3 (1954). In Russian.

Brief account of the measurements of differential cross-sections, obtained with counter telescopes in coincidence, so as to detect elastic events. Accurate results showing a steady decrease of differential cross-sections from about 5.4×10^{-27} cm^2/sterad at 20° to about 2×10^{-27} cm^2/sterad at 90° (in the centre-of-mass system) are given. G.Martelli

537.534.74

7971. SPIN–ORBIT COUPLING IN THE PROTON–PROTON INTERACTION. J.L.Gammel and R.M.Thaler.
Phys. Rev., Vol. 107, No. 1, 291-8 (July 1, 1957).

The proton–proton interaction is examined at high energies. A phenomenological potential is derived from the scattering data. In the triplet state, this potential has a strong short-range ($\sim 0.4 \times 10^{-13}$ cm) repulsive core region, outside of which a long-ranged tensor force and extremely short-range spin–orbit ($L \cdot S$) force are effective. Good fits can be obtained to all the p–p data below 310 MeV. More important, at 310 MeV the calculated phase-shifts are very close to the phase-shifts which give the best fit found in a phase-shift analysis of the 310 MeV data, and at all lower energies precision fits to the experimental data can be obtained by very slight (if any) changes in the calculated phase-shifts. A.

537.534.74 : 530.145

STRUCTURE OF THE PROTON AND ELECTRON–PROTON SCATTERING. See Abstr. 7593

537.534.74 : 539.172.13

PROTON–NUCLEUS SCATTERING AT 9.8 MeV. See Abstr. 7376,7377

537.534.79

7972. ON A POSSIBLE METHOD OF POLARIZING PROTON BEAMS. E.K.Zavoĭskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 408 (1957). In Russian.

It is suggested that protons might be polarized by passing them through a ferromagnetic foil in which they pick up polarized electrons, and then ionizing the polarized hydrogen atoms in a second foil or stream of gas. J.W.G.Wignall

DISCHARGE TUBES. COUNTERS 537.54

537.542 : 621.373.43.018.752 : 621.387.42

7973. FEEDING OF A GEIGER–MÜLLER COUNTER WITH A PULSED VOLTAGE. L.Mitrani and M.Drazhev.
Izv. Bulg. Akad. Nauk., Vol. 5, 67-75 (1955). In Bulgarian with summaries (1 p.) in Russian and (1 p.) in English.

A new type of square-wave generator was used to superpose pulsed voltage upon the d.c. counter voltage which was fixed below the threshold value, thus bringing the total counter voltage repeatedly into the Geiger region. The variations in the average counter current with pulse frequency, for different values of τf (where τ = width of the pulse, and f = pulse frequency) are given. The existence of marked maxima is established. The maxima are shown to be independent of the intensity of radiation or small variations of the pulsed voltage. J.M.Zarzycki

537.542 : 548.733

7974. A PROPORTIONAL COUNTER TUBE FOR X-RAY DIFFRACTION ANALYSIS.
F.H.Sumner and D.P.D.Webb; A.R.B.Skertchly.
J. sci. Instrum., Vol. 34, No. 5, 209-10 (May, 1957).

Points out some errors in a mathematical paper by Skertchly (see Abstr. 5167/1956). Skertchly replies. J.Thewlis

537.542

7975. A GEIGER COUNTER DESIGN GIVING A DEFINITE COUNTING LENGTH. P.J.Grouse and H.D.Rathgeber.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 707-16 (March, 1957).

A design of Geiger counter is described which is simple to make and the effective length of which is readily obtainable from its geometry and operating voltage. The results of field calculations and measurements agree. The operating voltage is chosen such that variations of effective length due to voltage fluctuations are minimized. A.

537.542 : 537.561

PHOTOIONIZATION COUNTER FOR DETERMINATION OF IONIZATION POTENTIAL. See Abstr. 7189

537.542

7976. IONIZATION CHAMBER FOR X-RAYS UP TO 31 MeV. F.Ferrero, R.Malvano and C.Tribuno. Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 510-12 (Feb., 1957). In Italian.

537.542

7977. REMARKS ON DOUBLE SOLUTE LIQUID SCINTILLATORS. P.Avivi and A.Weinreb. Rev. sci. Instrum., Vol. 28, No. 6, 427-9 (June, 1957).

The behaviour of wavelength shifters in liquid scintillators is discussed. The properties necessary in order that a fluorescent compound should act as a wavelength shifter are considered in detail and a qualitative criterion for efficient wavelength shifting is presented. Several double solute solutions have been tested. A.

537.542 : 541.64

7978. PREPARATION OF LARGE PLASTIC SCINTILLATORS. G.W.Clark, F.Scherb and W.B.Smith. Rev. sci. Instrum., Vol. 28, No. 6, 433-7 (June, 1957).

A process is described for the manufacture of disks of plastic scintillators weighing over 100 kg and composed of polystyrene (~99%), p-terphenyl (~1%), and POPOP,p-bis [2-(5-phenyloxazolyl)]-benzene, (~0.03%). The design and performance of two large plastic scintillation detectors for cosmic rays are discussed. A

537.542 : 539.185.08

7979. BORON-LOADED LIQUID SCINTILLATION NEUTRON DETECTORS. L.M.Bollinger and G.E.Thomas. Rev. sci. Instrum., Vol. 28, No. 7, 489-96 (July, 1957).

The general problems involved in constructing boron-loaded liquid scintillation neutron detectors are considered. The characteristics of particular counters which have been successfully used in neutron transmission measurements by the time-of-flight method are then described. The design of these counters was guided by the results of a Monte Carlo study of neutron capture in a boron-poisoned medium. This calculation gives the probability of neutron capture as a function of neutron energy, counter thickness, and time. The calculated results are compared with experimentally determined efficiencies. The advantages and problems encountered in using the boron-loaded liquid scintillator with the Argonne fast neutron chopper are discussed. A.

537.542

7980. FAST COINCIDENCE WITH FAST DISCRIMINATORS. R.Bhattacharyya and S.Chatterjee. Indian J. Phys., Vol. 31, No. 1, 53-5 (Jan., 1957).

A simple arrangement using fast discriminators with a fast coincidence circuit is described. With this a resolving time of ten milli-microseconds can be easily obtained. The main features of this arrangement are its stability and simplicity. A.

537.542 : 539.166.08

7981. X-RAY ESCAPE GATING AS APPLIED TO A PROPORTIONAL COUNTER. C.W.McCutchen. Nuclear Physics, Vol. 3, No. 1, 76-82 (March, 1957).

A method of low-energy γ-spectroscopy is described which employs a xenon-filled proportional counter and a NaI scintillation counter. The xenon counter is placed in the gamma flux while the scintillator counts the xenon fluorescence X-rays which follow photoelectric absorption of γ-rays in the proportional counter. A pulse from the proportional counter is passed to the kicksorter only when the scintillator receives a xenon K X-ray. The recorded spectrum thus contains only K X-ray escape peaks and is easy to interpret. The method is described in detail and a practical example is given. A possible extension of the method to conversion-electron spectroscopy is proposed. A.

537.542

7982. BUBBLE DENSITY ALONG THE PATH OF IONIZING PARTICLES CROSSING A BUBBLE CHAMBER. L.Bertanza, G.Martelli and B.Tallini. Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 940-6 (April, 1957).

The formation of bubbles along the path of charged particles in a bubble chamber is investigated, and the various processes which contribute to the formation of a track are analysed. The dependence of the density of bubbles on the velocity of the particles and on the degree of superheat of the liquid is studied, and it is shown that the contradiction between some experimental results is only apparent and may be explained in terms of different conditions of operation. A.

537.542

7983. DESIGNING FOR SAFETY IN HYDROGEN BUBBLE CHAMBERS. H.P.Hernandez, J.W.Mark and R.D.Watt. Rev. sci. Instrum., Vol. 28, No. 7, 528-35 (July, 1957).

The principal hazards of operating a liquid hydrogen bubble chamber are failure of equipment (due to overpressure) and uncontrolled escape of hydrogen gas, which may cause an explosion. If safety considerations are incorporated in planning from the job beginning, components can be designed to reduce or eliminate the probability of accidents arising from the known hazards. The degree of safety, the hydrogen safety-vent system, and the hazards, and operation of some liquid hydrogen bubble chambers are discussed. A

537.542 : 531.787.2

7984. BUBBLE CHAMBER PRESSURE GAUGE. W.I.Linlor, Q.A.Kerns and J.W.Mark. Rev. sci. Instrum., Vol. 28, No. 7, 535-41 (July, 1957).

A description is given of the mechanical gauge and electrical circuit employed for measuring millisecond pressure pulses in a liquid hydrogen bubble chamber, in a pulsed magnetic field region. The pressure pulse produces a deflection of a diaphragm that acts as one electrode of a capacitor. The change in capacitance is measured in an electrical circuit by comparison with a reference capacitor. A common source feeds two cables, one of which is terminated by the pressure-measuring capacitor ("transducer"), the other by the adjustable comparison unit. Pulses from the common source are reflected from the two terminations, and their difference is amplified and displayed. The circuit employed is such that the distributed capacitance of the cables does not affect the sensitivity of the system. Hence, the interconnecting cables are not limited in length up to several thousand feet. The frequency-response limit is about 10 kc/s for units currently used, because of the diaphragm characteristics. Steady-pressure calibration can be employed in order to determine the pressure and output relation. A

IONIZATION. THERMIONICS 537.56/.58

537.56/.5

7985. ON THE MEASUREMENT OF ION DENSITIES WITH THE AID OF PERFORATED PROBES IN HIGH-FREQUENCY ELECTRIC DISCHARGES. A.Pozwolski. C.R. Acad. Sci. (Paris), Vol. 244, No. 13, 1744-6 (March 25, 1957). In French.

This was carried out in H_2 and A using a previously established technique (Abstr. 6741/1956). The number of ions is shown to vary inversely with pressure and is ~ 0.1% at 5×10^{-3} mm Hg in H_2; there was an absence of negative ions in A. A.E.D.Heyles

537.56

7986. SCATTERING OF LOW-ENERGY H^- IONS IN HELIUM, NEON, AND ARGON. T.L.Bailey, C.J.May and E.E.Muschlitz, Jr. J. chem. Phys., Vol. 26, No. 6, 1446-51 (June, 1957).

Elastic and inelastic cross-sections have been measured at incident ion energies in the range 5 eV to 350 eV. One term interaction potentials of the form $V = -K/r^n$ were calculated from the low-energy elastic cross-sections. These potentials were: for H^- and He, $V = -2.90/r^{3.01}$ eV for r = 1.30 A to 1.90 A; for H^- and Ne, $V = 4.17/r^{2.80}$ eV for r = 1.00 A to 1.78 A; and for H^- and A $V = 7.82/r^{3.40}$ eV for r = 1.23 A to 2.12 A. The observed inelastic cross-sections are interpreted as cross-sections for electron detachment from H^-; they show a similar behaviour with ion energy W in the three cases, appearing at W between 0 and 5 eV, rising rapidly to W = 40 eV, and then rising very slowly to W = 350 eV. Evidence was found for positive ion formation in H^- collisions with Ne and A atoms at ion energies above 100 eV.

537.56

7987. INTERCHANGE OF CHARGE BETWEEN GASEOUS MOLECULES IN RESONANT AND NEAR-RESONANT PROCESSES. E.F.Gurnee and J.L.Magee. J. chem. Phys., Vol. 26, No. 5, 1237-48 (May, 1957).

Interchange of charge between monatomic and diatomic ions and molecules in gaseous systems is considered theoretically by an "impact parameter" method. Formulae for charge transfer cross sections for resonant and near-resonant cases are developed, and comparisons are made between experimental and theoretical results. The validity of the impact parameter method is considered by comparison with the more rigorous method of scattered waves.

537.564

7988. NEGATIVE ION FORMATION IN HYDROGEN CHLORIDE BY ELECTRON IMPACT. R.E.Fox.
J. chem. Phys., Vol. 26, No. 5, 1281-4 (May, 1957).

The energy dependence for the formation of Cl^- from HCl vapour by dissociative attachment of electrons is studied with a mass spectrometer. Within experimental error the low-energy onset for the capture process occurs at the same energy as that for the maximum capture cross-section which is determined to be at 0.66 eV. The ion pair formation process, $HCl + e \rightarrow H^+ + Cl^-$, is found to have a linear onset at 14.5 eV. The maximum yield of negative ions by this process is found to be only a few per cent of that from the low-energy capture process. The energy distribution of the electron beam and the calibration of the energy scale is obtained by comparison with SF_6^-. It is observed that when a low-energy electron capture process is possible, spurious effects may be obtained at higher electron energies due to low-energy secondary electrons ejected from electrode surfaces by the primary beam. A.

537.564

7989. COLLISION-INDUCED DISSOCIATIONS IN THE MASS SPECTRUM OF ACETYLENE.
C.E.Melton, M.M.Bretscher and R.Baldock.
J. chem. Phys., Vol. 26, No. 5, 1302-9 (May, 1957).

The pressure dependence of these transitions was investigated in the range from 2×10^{-7} to 3×10^{-6} mm of Hg. Relative cross-sections are given and compared with the corresponding ones for dissociation by electron impact. A metastable transition corresponding to the reaction $C_2H^+ \rightarrow C_2^+ + H$ was observed. A.

537.564

7990. A VARIATIONAL CALCULATION OF THE CROSS SECTION FOR THE 1s-2s EXCITATION OF HYDROGEN BY ELECTRON IMPACT. B.H.Bransden and J.S.C.McKee.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 398-400 (May, 1957).

A method based on Schwinger's procedure is applied to the inelastic collision problem, using simple (N-term) polynomials as trial wave-functions. Exchange has been neglected. Calculated zero-order partial cross-sections for incident energies up to 54 eV, with N = 1,2, and 3, are compared with those given by numerical integration. The cross-sections converge rapidly with N, and good agreement is observed for N = 3. N.M.King

537.564

7991. NEGATIVE IONS OF Si, Ge, Sn AND Pb.
V.M.Dukel'skiĭ and V.M.Sokolov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 394-5 (1957). In Russian.

Continuation of Dukelskiĭ's studies (see Abstr. 2361/1957) on negative atomic ion formation, dealing here with Group IV, subgroup B of the periodic table. Ions were obtained by the method of the above paper (Abstr. 2361/1957) or by the interaction, in an ion source, of an electron beam with halide molecules of the element of interest. Analysis and recording of the ions was done on a mass spectrometer of sufficient resolving power to separate the isotopes of Pb. Experimental conditions and results given for each element. C.R.S.Manders

537.565

7992. THE MOBILITY OF He^+ IONS IN HELIUM.
N.Lynn and B.L.Moiseiwitsch.
Proc. Phys. Soc. A, Vol. 70, Pt 6, 474-8 (June, 1957).

Describes the calculation of ionic mobility in the case of He^+ in He, using the appropriate interaction energies worked out previously by Moiseiwitsch. The temperature range studied was from 50^0 K to 1000^0 K. The results agree well with the experimental data of Chanin and Biondi. J.D.Craggs

537.567

7993. DEPENDENCE OF THE AVERAGE CHARGE OF AN ION ON THE DENSITY OF THE SURROUNDING MEDIUM.
J.Neufeld and W.S.Snyder.
Phys. Rev., Vol. 107, No. 1, 96-102 (July 1, 1957).

The experiments of Lassen revealed the existence of two "density effects" expressing a dependence of the average charge of a moving heavy ion on the density of the surrounding medium. These are as follows: (1) the "pressure effect" characterizing gases and (2) the "state of condensation effect" characterizing solids and liquids. According to Bohr and Lindhard, these two effects are phenomenologically analogous since they involve a relationship between the times separating successive collisions of the moving ion and the times required for the excited orbital electrons to readjust themselves either by radiation or by redistribution of their excitation energy. It is conjectured that the phenomenological similarity may not be complete since in determining the state of condensation effect one also has to take into account the effect of a polarizing field due to the reaction of the perturbed medium on the moving ion. This field causes spontaneous emission of electrons carried by the ion, thus increasing the effective charge of the ion. A relationship is established between various values of the polarizing field and the corresponding average charge of an incident heavy ion in which the orbital electrons are continually maintained in an excited state due to the recurrent collisions with the atoms in the surrounding medium. The value of the polarizing field is determined for a particular case of a heavy fission fragment in gold and by applying this value to the above relationship it is shown that the contribution of the autoionization is substantial. Therefore, this contribution should be taken into account in determining the cause of the "state of condensation effect". The "autoionization" is due to "distant collisions", i.e., to the portion of the medium relatively far removed from the particle track, whereas the effect of Bohr and Lindhard is due to "close collisions" with atoms adjacent to the track. A.

537.568

7994. ELASTIC AND INELASTIC SCATTERING OF LOW-VELOCITY He^+ IONS IN HELIUM. W.H.Cramer and J.H.Simons.
J. chem. Phys., Vol. 26, No. 5, 1272-5 (May, 1957).

Cross-sections have been measured for both elastic and inelastic collisions of He^+ ions in the energy range from 4 to 400 eV with helium atoms in the gas phase. Charge exchange was the only inelastic process observed except at the highest energies, where very small cross-sections for ionization were obtained. Cross-sections for charge exchange decreased slowly with increasing ion energy. The potential functions determined from the elastic scattering data are $V = -34.5r^{-6.88}$ for $r > 1.7$ A and $V = -5.15r^{-2.90}$ for $r < 1.7$ A. Assuming an equilibrium distance of 1.1A the interaction energy for the formation of the molecular ion He_2^+ is calculated to be 3.9 eV. A.

537.568

7995. ON A NEW PHENOMENON IN ACTIVATED NITROGEN.
J.Berkowitz.
Proc. Phys. Soc. A, Vol. 70, Pt 6, 480-3 (June, 1957).

Discusses certain observations by Stanley (Abstr. 8595/1955) on a luminous beam effect in nitrogen (mm pressures) with about 10 mA a.c. flowing. Stanley suggested that the luminosity was due to the metastable $A\,^3\Sigma_u^+$ state of N_2. Berkowitz criticizes this suggestion and postulates radiative recombination involving N_2^+; reasons are given in the note. J.D.Craggs

COSMIC RAYS 537.591

537.591

7996. LEVEL FLIGHTS WITH EXPANSIBLE BALLOONS.
J.E.Laby, Y.K.Lim and V.D.Hopper.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 249-59 (Jan., 1957).

Single rubber or neoprene balloons have been used to obtain level flights at altitudes in the region 80 000-105 000 feet to expose nuclear emulsion plates to cosmic radiation. String operated valves have been developed and a comparison is made of the performance of various sizes of rubber and neoprene balloons. On some flights a clock released a load after the balloon had levelled off and for these the new ceiling height has been investigated. A.

537.591 : 523.11

7997. THE EXTRAGALACTIC DENSITY OF COSMIC RADIATION. K.Sitte.
Bull. Res. Coun. Israel, Vol. 6A, No. 1, 61-4 (Oct., 1956).

The random-walk model of cosmic ray origin leads to a continuous leakage through the surface of the galaxies, and to a corresponding accumulation of radiation in intergalactic space. It is shown that, with plausible assumptions for the cosmological model, the intergalactic density of cosmic rays passes through a maximum at an early stage of the expansion and now approaches a value which is at least not by orders of magnitude smaller that the galactic density of cosmic radiation. The extragalactic propagation of cosmic radiation is, therefore, a phenomenon worth studying, and its implications for the cosmological development may well be far-reaching. A.

537.591.15

7998. THE ENERGY SPECTRUM OF NUCLEONS IN THE AIR SHOWER. Y.Tanaka, K.Suga and S.Mitani.
J. Phys. Soc. Japan, Vol. 12, No. 2, 215 (Feb., 1957).

Energy distributions of nucleons in air showers have been obtained indirectly from two counter arrays. The energy distributions are flattest and the proportion of high-energy nucleons largest close to the core of the air shower. A.J.Egginton

537.591.15

7999. A CALCULATION ON THE STRUCTURE OF THE NUCLEONIC CASCADE IN THE ATMOSPHERE. M.Oda.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 615-27 (March, 1957).

Hypothetical models of the nucleonic cascade are used for interpreting cosmic-ray air showers. Numerical calculations are made on energy and angular distributions of π-mesons and μ-mesons produced at each generation of the nucleonic cascade. The number of electrons and μ-mesons at sea level and their lateral distribution are also derived. Assumptions on the nucleon–nucleus interaction are adjusted so that results of the calculation agree with experimental results on air showers. A.

537.591.15

8000. ON THE SPATIAL DISTRIBUTION OF THE PENETRATING COMPONENT OF EXTENSIVE ATMOSPHERIC SHOWERS. É.L.Andronikashvili and M.F.Bibilashvili.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 403-4 (1957). In Russian.

This is measured at a depth of 65.5 m water equivalent. It is also concluded that more than 70% of the energy of extensive atmospheric showers at sea level is concentrated in the penetrating component. J.W.G.Wignall

537.591.5

8001. THE EFFECT OF THE EAST–WEST ASYMMETRY ON THE DISTRIBUTION OF FAST TRACKS FROM STARS PRODUCED BY COSMIC RAYS IN NUCLEAR EMULSIONS. M.Morand, C.Beets, Y.Robinet and L.Winand.
Ann. Soc. Sci. Bruxelles I, Vol. 71, No. 1, 44-52 (1957). In French.

It is shown that the distribution of tracks from cosmic ray induced stars in nuclear emulsions, within the energy range 50-250 MeV, exhibits an East–West asymmetry. A.J.Egginton

537.591.5

8002. ON THE CORRELATION OF THE INTENSITY OF μ^-- AND μ^+-MESONS WITH THE PRESSURE AT SEA-LEVEL, AND WITH THE HEIGHT OF THE 100 mb LAYER. U.Fasoli, C.Maroni, I.Modena, E.Pohl and J.Pohl-Ruling.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 473-82 (Feb., 1957).

The vertical intensities of μ^+- and μ^--mesons have been measured by means of a counter apparatus with magnetic discrimination for the sign of charge. The mean daily counting rates are 5500 μ^+ and 4600 μ^- extended over 18 months. The coefficients for correlation between the intensities of the μ^+ and μ^- with the atmospheric pressure at sea-level (α^+ and α^-) and with the height of the 100 mb layer (γ^+ and γ^-) have been obtained. There is a difference between the coefficients for the two types of mesons which is beyond the statistical errors; in fact $|\alpha^-| > |\alpha^+|$ and $|\gamma^+| > |\gamma^-|$. The results have been interpreted by means of a particular integral of the diffusion equation, considering the mesons as being produced by two distinct sources: one due to the collisions between the primary component with the nuclei of the upper atmosphere and the other due to the secondary nucleonic component. A.

537.591.5 : 539.18

VARIATIONS OF THE FLUX OF PROTONS AND π-MESONS WITH DEPTH. See Abstr. 7433

MAGNETISM 538

538.11 : 548.7

8003. SUSCEPTIBILITY AND CURIE POINT OF MAGNETICALLY DILUTE CRYSTALS. R.E.Behringer.
J. chem. Phys., Vol. 26, No. 6, 1504-7 (June, 1957).

The Opechowski calculation of the apparent Curie point, T_C, is extended to the case of magnetically dilute f.c.c. crystals. To first order in temperature the result is equivalent to a molecular field treatment. The calculation is carried to fourth order in temperature and a plot is made of T_C v. p, the fractional concentration of magnetic atoms. The theoretical result is compared to some existing experimental data and values of the exchange interaction, J, are estimated. The above calculation is found to be useful only for $0.8 \leq p \leq 1.0$. For low concentrations a crude calculation is made based on clusters of magnetic atoms. To first order in temperature a linear relationship is found between apparent Curie point and concentration. A

538.11

8004. DETERMINATION OF THE VALUE OF THE BOHR MAGNETON BY A RESONANCE METHOD IN IONIZED AIR. S.Procopiu and C.Papusoi.
C.R. Acad. Sci. (Paris), Vol. 244, No. 14, 1905-7 (April 1, 1957). In French.

Measures the resonance frequency ν for a free electron beam under the action of a magnetic field H parallel to the beam and a high-frequency field perpendicular to it, and obtains $\mu_B = h\nu/2H = 0.933 \times 10^{-20}$, compared with 0.927×10^{-20}, the recognized value. E.P.Wohlfarth

538.11

8005. ON A HIGHER APPROXIMATION OF THE CRITICAL FIELD STRENGTH FOR AN ANTIFERROMAGNETIC. K.F.Niesse
Philips Res. Rep., Vol. 12, No. 3, 259-69 (June, 1957).

The critical magnetic field strength is derived for an antiferromagnetic with different anisotropy constants for the two sublattices account being taken of the field-strength dependence of the parallel and perpendicular susceptibilities and a higher approximation of the anisotropy energy. Special attention is paid to the variation of the critical field strength for a small deviation of the external field from the preferential axis. Results for the case of equal and unequal anisotropy constants are given. A

538.12

8006. PRODUCTION OF VERY STRONG MAGNETIC FIELDS BY MEANS OF A RAPID COMPRESSION OF CONDUCTING SHELLS. Ya.P.Terletskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 387-8 (1957). In Russian.

A method is described which enables one, in principle, to obtain magnetic fields greater than 10^5 oersteds. It is based on the idea that when a conducting shell, e.g. a conducting sphere, placed in a magnetic field is compressed uniformly so that its internal dimensions are reduced by a factor n in a time T, short compared with the relaxation time, τ, of the sphere, the magnetic field inside the sphere increases n^2 times. Z.Krasuc

538.22 : 539.21

8007. NOTE ON SUPEREXCHANGE INTERACTIONS AND MAGNETIC LATTICES OF THE RHOMBOHEDRAL SESQUIOXIDES. S.Iida.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1300-1 (Dec., 1956).

The work of Li (Abstr. 5208/1956) is extended to cover an additional ionic configuration which may be important in determining the superexchange interaction in Cr_2O_3 and α Fe_2O_3. E.P.Wohlfar

538.221 : 538.652 : 534.2

8008. DYNAMIC MAGNETOSTRICTIVE PROPERTIES OF Ni–F ALLOYS. C.M.Davis, Jr, H.H.Helms and S.F.Ferebee.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 431-4 (April, 1957).

The dynamic magnetostrictive properties of Ni–Fe alloys containing from 35% to 67.5% nickel were investigated to determine their suitability for use in electromechanical transducers. The material, in the form of toroids made from ring laminations, was evaluated by the motional impedance method. Annealing temperatures were varied from 600° C to 1220° C, and the effect of various annealing techniques was investigated. Measured values of the electromechanical coupling coefficient, the reversible permeability, the dynamic magnetostrictive constant, and other parameters are given. The electromechanical coupling coefficient for alloys containing from 40% to 52.5% nickel was greater than 0.31. A maximum value of 0.37 was found for the 40% nickel alloy. The product of the magnetostrictive constant and the reversible permeability for the above range of alloys was greater than 95×10^4 (dyn oersted^{-1} cm^{-2}) and reached a maximum value of approximately 130×10^4 for the alloy containing approximately 40% nickel.

538.221

8009. SLOW REMAGNETIZATION TIMES IN 4—79 MOLYBDENUM PERMALLOY. J.D.Blades and R.A.Tracy.
J. appl. Phys., Vol. 28, No. 4, 516 (April, 1957).

Measurements of τ are described for a 0.125×10^{-3} in. toroidal core, and τ^{-1} was found to increase up to 10^6 sec^{-1} as $(H-H_0)$ increased to about 0.3 Oe, where the critical field $H_0 = 0.138$ Oe. The remagnetization process taking place is discussed. E.P.Wohlfarth

538.221 : 538.653

8010. MANIFESTATION OF INTERNAL STRESSES IN THE ALLOY 50Ni—50Fe BY MEANS OF BITTER PATTERNS. C.Greiner.
Naturwissenschaften, Vol. 44, No. 1, 8-9 (1957). In German.

Describes results of experiments on thin wires in the neighbourhood of imperfections (holes, scratches) and for a drawn specimen. The appearance of the patterns is a result of strain anisotropy. E.P.Wohlfarth

538.221 : 539.373 : 621.318.12

8011. CONTROLLED CRYSTAL ANISOTROPY AND CONTROLLED TEMPERATURE DEPENDENCE OF THE PERMEABILITY AND ELASTICITY OF VARIOUS COBALT-SUBSTITUTED FERRITES. C.M.van der Burgt.
Philips Res. Rep., Vol. 12, No. 2, 97-122 (April, 1957).

Dynamic elasticity at remanence, piezomagnetic coupling at remanence, and initial permeability of polycrystalline toroids of various cobalt-substituted ferrites were determined in the temperature range from −196° C to +120° C at least. The compositions are represented approximately by $(M_{1-y}Zn_y)_{1-x}Co_xFe_2O_4$, where M stands for one of the divalent metal ions $Li^{+}_{1/2}Fe^{3+}_{1/2}$, Ni^{2+}, and Mn^{2+}. The first-order magnetocrystalline anisotropy constant K_1 of cobalt ferrite is known to be large and positive (2 to 3×10^6 J/m^3). Consequently the incorporation of a small amount of cobalt ferrite in solid solution in other ferrites that have $K_1 < 0$ (ferrous, nickel, manganese ferrites, and presumably lithium ferrites) leads to a compensation of crystal anisotropy at a transition temperature T_0 depending on the amount of cobalt ferrite. At room temperature the compensating effect of cobalt substitutions in ferrous ferrite is nearly four times as strong as expected from simple linear interpolation. On the other hand cobalt substitutions in manganese ferrite appear to be less effective than expected, the compensating amount of cobalt being about four times that expected. Nevertheless the curves T_0 v. x for all systems of cobalt-substituted mixed ferrites have a similar shape. The fact that the crystal anisotropy passes through zero at a temperature T_0 implies that around this temperature only strain anisotropy and pore-shape anisotropy remain, so that there exists a small temperature range where the substance is magnetically and magnetoelastically soft. The resulting peaks in the permeability and compliance, together with the overall increase of these quantities with temperature, lead to temperature ranges somewhere above T_0 where the permeability and the elasticity are substantially temperature independent. A.

538.221

8012. MICROWAVE RESONANCE RELATIONS IN ANISOTROPIC SINGLE-CRYSTAL FERRITES. J.O.Artman.
Phys. Rev., Vol. 105, No. 1, 62-73 (Jan. 1, 1957).

For abstract, see Abstr. 3445 (1957).

538.221

8013. ANTIFERROMAGNETIC RESONANCE IN Cr_2O_3. E.S.Dayhoff.
Phys. Rev., Vol. 107, No. 1, 84-91 (July 1, 1957).

The antiferromagnetic resonance spectrum of single-crystal Cr_2O_3 has been mapped within the wavelength region from 12 mm to 2.8 mm and magnetic field intensities from 0 to 30 000 Oe. The resonance frequencies were observed in this region in a temperature interval from about 17° C to 35° C, the Néel temperature, T_N. When the [111] crystal axis is perpendicular to the direction of the external magnetic field, the observed resonance locus on a frequency v. magnetic field diagram forms a single curve at each temperature; when the two are parallel, the resonance locus forms a curve of two branches, one of which has not previously been observed for this material. These loci are found to be in good agreement with the resonance theory of Nagamiya, and of Keffer and Kittel. Good theoretical agreement is also found for variations of line width with magnetic field strength and for variations in the peak absorption intensity at resonance. The anisotropy energy K which depends upon the temperature, T, as obtained from the data is proportional to $(T_N-T)^{0.87}$ over the observable interval. Assuming that K is proportional to a fixed power of sublattice magnetization at all temperatures and that sublattice magnetization behaves as the appropriate Brillouin function of temperature, one can extrapolate to absolute zero and thus find K = 800 000 ergs/cm^3. A.

538.221

8014. THE EFFECT OF GRAIN SIZE ON THE MAGNETO-THERMAL PROPERTIES OF FERRITES. D.A.Christoffel.
Proc. Phys. Soc. B, Vol. 70, Pt 6, 623-5 (June, 1957).

A continuation of previous work (Abstr. 5464/1957), giving further data on specimens of $Ni_xCo_{1-x}Fe_2O_4$ (x = 1.00 and 0.98) having particle sizes in the ranges 1-5μ and 5-10μ. For the pure ferrite a critical size effect was observed. E.P.Wohlfarth

538.221

8015. COMMENTS ON THE MANUEL MODEL FOR MnBi. R.R.Heikes and B.W.Roberts.
Proc. Phys. Soc. B, Vol. 70, Pt 7, 711 (July, 1957).

See Abstr. 536 (1957). Shows that the model proposed by Manuel for the interpretation of the magnetic properties of MnBi and MnAs leads to a value for the Curie constant that is 10 times larger than that observed. The model is also inconsistent with neutron diffraction observations. J.Thewlis

538.222

8016. A SOLID STATE PARAMAGNETIC RESONANCE SPECTROMETER. P.M.Llewellyn.
J. sci. Instrum., Vol. 34, No. 6, 236-9 (June, 1957).

A spectrometer is described for use in the frequency range 9000 to 10 000 Mc/s and at the fixed temperatures of boiling refrigerants and a small range below obtained by pumping on the liquid. The lowest temperature available is the triple point of hydrogen (14° K). A high sensitivity is achieved by modulating the magnetic field at 115 kc/s. The sensitivity is such that 10^{13} atoms of Co^{56} have been detected at 20° K with a signal/noise ratio of 3 : 1; it is estimated that 2×10^{-11} moles of the free radical diphenyltrinitro phenyl hydrazyl (DPPH) would be detectable at 290° K. A.

538.222 : 621.317.789.029.6

8017. A FREQUENCY MODULATED MICROWAVE SPECTROMETER FOR ELECTRON RESONANCE MEASUREMENTS. A.C.Rose-Innes.
J. sci. Instrum., Vol. 34, No. 7 276-8 (July, 1957).

A spectrometer for use in the 3 cm microwave band is described. Use of a frequency modulation method allows spectra to be recorded with simple equipment, and details are given of a special technique for increasing the sensitivity. The method is especially suitable for measurements at low temperatures and for the recording of wide lines. A.

538.244.2 : 621.318.3

8018. DESIGN AND PERFORMANCE OF A HIGH-EFFICIENCY LABORATORY ELECTRO-MAGNET. L.O.Bowen.
J. sci. Instrum., Vol. 34, No. 7, 265-8 (July, 1957).

Major factors required in the performance of laboratory electromagnets, namely field intensity and field homogeneity over accessible working volumes, have been achieved with moderate power consumption in an iron-clad magnet yielding power efficiencies [power efficiency ∝ (air-gap induction × air-gap)/ampere-turns] approximately 10% in excess of those obtained from similar magnets as previously reported. The magnet and support weighs 2½ tons and operates from an 18 kW d.c. supply. Pole-face diameters range from 11.5 to 1.5 in. with a range of air gaps from 5 to 0.5 in. Design procedure and data are reproduced. A.

538.245

8019. NEW TYPE OF MAGNETIC TRANSITION IN Mn_3ZnC. B.N.Brockhouse and H.P.Myers.
Canad. J. Phys., Vol. 35, No. 3, 313-23 (March, 1957).

Alloys with the approximate composition Mn_3ZnC are known to be ferromagnetic but the saturation magnetization shows a maximum in the region of 231° K. X-ray and neutron diffraction measurements are reported which demonstrate that at 231° K there is a second-order transition below which ordering of the manganese ions occurs, resulting in a tetragonal distortion of the normally cubic lattice and a complex magnetic structure. One possible magnetic structure is discussed. Above the transition the alloy is apparently a normal ferromagnetic substance. A.

538.245 : 548.52

8020. THE CREATION OF A MAGNETIC STRUCTURE BY A MAGNETIC FIELD IN THIN LAYERS OF IRON, OBTAINED BY AN ELECTROLYTIC METHOD. N.V.Kotel'nikov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 1, 97-9 (1957). In Russian.

When depositing iron electrolytically a magnetic field can set up a uniaxial structure in the deposit with the axis of weak magnetization following the direction of the applied field. Since electrolysis normally takes place at low temperatures it is unlikely that the magnetic phenomenon of electrolytic iron is explainable by plastic

strain. The present paper shows how a magnetic structure can be accounted for taking into consideration the magnetostriction anisotropy of the separate little crystals and the process of formation of a polycrystalline deposit from them. A maximum ordered state is achieved for a field of several hundred oersteds, fields greater or less appear to be less effective. The anisotropic energy of a film obtained in the critical field may attain a magnitude of $5 \times 10^4 - 6 \times 10^4$ erg/cm^3. C.R.S.Manders

538.245

8021. THE STATISTICS OF FERROMAGNETIC ELEMENTARY PROCESSES AND THEIR INFLUENCE ON BARKHAUSEN NOISE. H.Bittel.
Forschungsber. Wirtsch.-Verkehrsmin. Nordrhein-Westfalen, No. 251, 42 pp. (1956). In German.

An elementary account of noise and stochastic processes as applied to Barkhausen reversals. The mean square noise voltage is calculated and shown to be proportional to the "Barkhausen volume". Experimental results on cylindrical Fe–Ni specimens show that the noise depends on the specimen shape (Abstr. 6342/1957). The statistical correlation of two reversals is investigated. The minimum and maximum times between the reversals are calculated and shown to depend, inter alia, on the demagnetizing factor. The frequency spectrum is also considered, and the correlation found to have a marked effect. E.P.Wohlfarth

538.245 : 538.65

8022. BITTER PATTERNS ON THIN SHEETS OF A 16% Al–Fe ALLOY. H.Gengnagel.
Naturwissenschaften, Vol. 43, No. 23, 534-5 (1956). In German.

Experiments on a single grain of a polycrystalline sheet (90μ) show that a uniaxial strain anisotropy is active even after prolonged annealing. Experiments on the sheet under external stresses enable the strain in the single grain to be estimated. E.P.Wohlfarth

538.245 : 539.11

8023. THE s–d EXCHANGE IN FERROMAGNETIC METALS. F.M.Gal'perin.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 381-2 (1957). In Russian.

The theory of the s–d exchange has been developed in detail by Vonsovskiĭ (Abstr. 7179/1955). In the present state of the theory it is not possible to evaluate exchange integrals between s- and d-electrons of the same atom and for neighbouring atoms, or the s-electron transfer integral. Up to now therefore it has been possible to demonstrate only qualitative agreement between theory and experiment. The present paper aims to show that the repeated integrals can be found by empirical methods and that when substituted in the Vonsovskiĭ relation for pure ferromagnetic metals the results give satisfactory agreement with experiments as shown in a table of data for Gd, Ni, Co and Fe. C.R.S.Manders

538.245 : 548.736.4 : 621.318.12

MAGNETIC PROPERTIES OF FERRITES $5Fe_2O_3.3M_2O_3$. See Abstr. 7509

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3/.5

538.3 : 532.5

8024. THE EQUILIBRIUM OF A SELF-GRAVITATING ROTATING INCOMPRESSIBLE FLUID SPHEROID WITH A MAGNETIC FIELD. J.Sykes.
Astrophys. J., Vol. 125, No. 3, 615-21 (May, 1957).

It is shown that there exists a solution of the equations of hydromagnetic equilibrium such that the field vanishes identically outside an oblate spheroid of small eccentricity, containing conducting fluid in non-rigid rotation. A.

538.3 : 532.5

8025. ON THE INDUCTION DRAG OF A SPHERE MOVING IN A CONDUCTING FLUID IN THE PRESENCE OF A MAGNETIC FIELD. K.P.Chopra.
Indian J. Phys., Vol. 30, No. 12, 605-10 (Dec., 1956).

Expressions for the induction drag experienced by (1) a uniformly magnetized sphere moving in an inviscid, incompressible, conducting fluid, and (2) an infinitely conducting sphere moving in an incompressible, inviscid and conducting fluid under the influence of an external uniform magnetic field are derived, subject to the condition that the currents do not seriously modify the magnetic field. It is found that the medium behaves as if it possesses viscosity of the order of $(\sigma/c^2)H_0^2a^2$. A comparison with viscous drag shows that the induction drag plays an important role when the condition, $H_0 . a > c\sqrt{\eta/\sigma}$, is satisfied. A possible application and limitations of the results are discussed. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

8026. ON STATIONARY SOLUTIONS OF THE HYDROMAGNETIC EQUATIONS. G.Carini.
R.C. Accad. Naz. Lincei, Vol. 22, No. 1, 38-43 (Jan., 1957). In Italian.

Alfvén's equations have been modified by introducing the relations $\vec{D} = \epsilon\vec{E} + \lambda\vec{v}_X\vec{H}$, $\vec{B} = \mu\vec{H} - \lambda\vec{v}_X\vec{E}$, where $\lambda = (\epsilon\mu - 1)/c$. Solutions of the modified equations corresponding to the uniform rotation of a liquid in the presence of an axial magnetic field agree with those derived from Alfvén's equations when $c\lambda/\sigma$ is negligible, but in general the induced magnetic field decreases with increasing axial distance. R.A.Newing

538.566 : 621.396.11

8027. THE DIFFRACTION OF AN ELECTROMAGNETIC WAVE BY A LARGE APERTURE. R.F.Millar.
Proc. Instn Elect. Engrs, Monogr. 213R, publ. Dec., 1956 (Vol. 104C, 240-50).

Republication of the monograph abstracted in Abstr. 1468 (1957).

538.566 : 621.396.11

8028. FUNDAMENTAL RADIO SCATTER PROPAGATION THEORY. E.C.S.Megaw.
Proc. Instn Elect. Engrs, Monogr. 236R, publ. May, 1957) (Vol. 104C, 441-55).

Republication of the monograph abstracted in Abstr. 6366 (1957).

538.566 : 621.372.8

8029. A NOTE ON THE EXCITATION OF SURFACE WAVES. A.L.Cullen.
Proc. Instn Elect. Engrs, Monogr. 239R, publ. May, 1957 (Vol. 104C, 472-4).

Republication of the monograph abstracted in Abstr. 5489 (1957).

538.566

8030. ON THE ELECTROMAGNETIC FIELD OF A DIPOLE IMMERSED IN A NONHOMOGENEOUS MEDIUM. I.Ferrari.
R.C. Accad. Naz. Lincei, Vol. 22, No. 2, 172-6 (Feb., 1957). In Italian.

538.566.2

8031. INFLUENCE OF COLLISIONS ON IONOSPHERIC REFLECTION. P.Poincelot.
C.R. Acad. Sci. (Paris), Vol. 244, No. 15, 2031-3 (April 8, 1957). In French.

Continuation of former work (Abstr. 9784-5/1955; 1407, 2256/1956). Considering a simple ionosphere and neglecting the effect of the earth's magnetic field, the influence of collisions is introduced as a damping term and an expression found for the reflection coefficient. G.M.Brown

538.566.2 : 621.396.11

8032. THE MODE THEORY OF V.L.F. IONOSPHERIC PROPAGATION FOR FINITE GROUND CONDUCTIVITY. J.R.Wait.
Proc. Inst. Radio Engrs, Vol. 45, No. 6, 760-7 (June, 1957).

The space between the earth and the ionosphere is considered as a waveguide with sharply bounded walls. Employing a representation in terms of spherical wave functions of complex order, the field of a vertical dipole source is calculated for very low frequencies. It is shown that the effect of the finite conductivity of the ground is quite important for propagation to great distances. Good agreement is obtained with the experimental results of J.Heritage, S.Weisbrod and J.Bickel (Symposium on propagation of very-low-frequency electromagnetic waves, Boulder, Colorado, Jan., 1957). A.

538.566.2 : 621.396.11

8033. THE "WAVEGUIDE MODE" THEORY OF THE PROPAGATION OF VERY-LOW-FREQUENCY RADIO WAVES. K.G.Budden.
Proc. Inst. Radio Engrs, Vol. 45, No. 6, 772-4 (June, 1957).

Relates to the theory in which the propagation of v.l.f. radio waves is treated by regarding the space between the earth and the ionosphere as a waveguide. Its purpose is to answer some criticisms of earlier papers by Budden (Abstr. 7804/1953). The earth is assumed to be a perfectly conducting plane, and the ionosphere is assumed to be a homogeneous medium with a sharp boundary. In general, there is no unique way of assigning numbers to the waveguide modes. The numbers are usually assigned by continuity with the case where the ionosphere is a perfect conductor, but this method fails for some values of the height and the conductivity. If the product of the height and the conductivity is less than a certain critical value, the attenuation for the zero order mode has a maximum at some frequency, and thereafter decreases as the frequency increases, as was found by Budden. If the critical value is exceeded, the attenuation for the zero order mode increases indefinitely with increasing frequency, as was found by Wait (see preceding abstract) and Liebermann (Abstr. 4572/1957). A.

MOLECULAR AND ATOMIC STRUCTURE

539.1

THEORY OF SOLID STATE 539.11

539.11

8034. ROLE OF SUBSIDIARY CONDITIONS IN THE COLLECTIVE DESCRIPTION OF ELECTRON INTERACTIONS. D.Bohm, K.Huang and D.Pines.
Phys. Rev., Vol. 107, No. 1, 71-80 (July 1, 1957).

The role of the subsidiary conditions in the Bohm—Pines collective description of electron interactions is discussed in detail. The subsidiary conditions are shown to be compatible with the approximations made in obtaining the Hamiltonian and energy of the many-electron system. Their effect on the ground-state energy and the specific heat is found to be small. A.

539.11

8035. TIGHT-BINDING METHOD FOR HEXAGONAL CLOSE-PACKED STRUCTURE. M.Miasek.
Phys. Rev., Vol. 107, No. 1, 92-5 (July 1, 1957).

Tables for reduction of the matrix components of energy in the tight-binding approximation have been prepared for the hexagonal close-packed lattice. A.

539.11 : 548.7

8036. F^{19} NUCLEAR MAGNETIC RESONANCE LINE SHAPES IN CaF_2. C.R.Bruce.
Phys. Rev., Vol. 107, No. 1, 43-5 (July 1, 1957).

The F^{19} magnetic resonances have been measured in CaF_2 with the magnetic field along the [100], [110], and [111] crystal directions and these data are compared with the data of Pake and Purcell. Calculations of the second and fourth moments for the new data further confirm the theory of Van Vleck on magnetic dipole interactions in solids since improved agreement with theory is obtained in the case of the magnetic field along the [111] crystal direction. Corrections of the moments for modulation broadening were small. A.

539.11 : 548.7

8037. FREE-INDUCTION DECAYS IN SOLIDS. I.J.Lowe and R.E.Norberg.
Phys. Rev., Vol. 107, No. 1, 46-61 (July 1, 1957).

A beat structure has been found on free-induction decays associated with the pulsed nuclear magnetic resonance of nuclei in rigid lattices. A general quantum-mechanical theory is developed for the shapes of induction decays. The theory is specialized to the case of rigid solids and applied to the magnetic dipolar interactions among the F^{19} nuclei in a fluorite (CaF_2) crystal. It is also shown rigorously that, except at very low temperatures, a free-induction decay is the Fourier transform of the corresponding steady-state resonance line shape. The calculation of the shape of an induction decay in CaF_2 thus corresponds to the calculation of the shape of the F^{19} resonance line for the crystal. It is demonstrated that the resonance line shape for an ordered rigid lattice is not Gaussian. A.

539.11 : 536.631

ON THE ELECTRONIC COMPONENT OF THE SPECIFIC HEAT OF TRANSITION METALS. See Abstr. 7831

539.11 : 536.631

ON THE ELECTRONIC SPECIFIC HEAT OF RHENIUM. See Abstr. 7832

MOLECULES 539.13

539.13 : 533.73

THERMAL RELAXATION IN CARBON DIOXIDE. See Abstr. 7669

539.132 : 541.57

8038. BOND ENERGIES OF TRANSITION METAL HALIDES. T.L.Allen.
J. chem. Phys., Vol. 26, No. 6, 1644-7 (June, 1957).

Bond energies of transition metal halides of the type MX_n have been calculated from existing thermodynamic data. It has been found that the Pauling equation for the bond energies of polar bonds, in conjunction with Eley's method of calculating metal—metal bond energies, is applicable to these molecules. A.

539.132

8039. A SIMPLIFIED PROCEDURE FOR CALCULATING THE COMPLETE HARMONIC POTENTIAL FUNCTION OF A MOLECULE FROM THE VIBRATIONAL FREQUENCIES. S.Brodersen.
K. Danske Vidensk. Selsk., mat.-fys. Skr., Vol. 1, Paper 4, 34 pp. (1957).

A method is described for deriving extremely simple relations between vibrational frequencies and force constants. It is based on the usual F- and G-matrices and on external symmetry coordinates. The translations and rotations are not removed from the symmetry coordinates. Instead a number of simple relations between the force constants are introduced. The calculation of the force constants corresponding to a given set of internal coordinates is discussed. As examples are discussed: ethylene (with a detailed numerical calculation), acetylene and ethane. In an appendix a few hints are given on the numerical calculations. A.

539.132

8040. EFFECT OF ROTATIONAL DISTORTION ON THE VIBRATION—ROTATION SPECTRA OF LINEAR MOLECULES. G.Amat and H.H.Nielsen.
C.R. Acad. Sci. (Paris), Vol. 244, No. 18, 2302-4 (April 29, 1957). In French.

The method of combination differences assumes the usual expression for the rotational energy including the coefficients of centrifugal and rotational distortion. This expression is shown to be invalid for small values of J, a case which arises if rotational distortion is due only to l-type resonance. An alternative expression is given for the combination differences, taking account of l-type doubling and a limiting form of the correction term introduced, makes it possible to use the simple expression for rotational energy in such a case. R.C.Seymour

539.132

8041. A GEOMETRIC VISUALIZATION OF NORMAL-COORDINATE TRANSFORMATIONS. APPLICATION TO THE CALCULATION OF BOND-MOMENT PARAMETERS AND FORCE CONSTANTS. W.B.Person and B.Crawford, Jr.
J. chem. Phys., Vol. 26, No. 5, 1295-301 (May, 1957).

Two methods are given for factoring the normal-coordinate transformation into transformations easier to visualize geometrically. The relations thus obtained have been used in a simple one-dimensional representation of the force constants and bond-moment parameters for CF_4 and C_2F_6. By this means one can easily investigate the existence of force fields which will bring the bond-moment parameters for CF_4 and the A_{2u} class of C_2F_6 into agreement. A further application to the problem of choosing the best force constants for a pair of isotopic molecules is shown for the B_{3u} class of ethylene. A.

539.132

8042. PERPENDICULAR BANDS OF ALLENE. K.Narahari Rao, A.H.Nielsen and W.H.Fletcher.
J. chem. Phys., Vol. 26, No. 6, 1572-5 (June, 1957).

An analysis of the experimental data concerning the four type E fundamental vibration-rotation bands of allene resulted in the following molecular constants for allene: $A = 5.0_4\ cm^{-1}$ or $I_A = 5.5_8 \times 10^{-40}\ g\,cm^2$; $r_{C-H} = 1.06_9$ A; and angle HCH = $\gamma = 116.^0_9$. A.

539.132 : 537.228.5

8043. HIGH-FIELD STARK EFFECT IN LINEAR ROTORS. M.Peter and M.W.P.Strandberg.
J. chem. Phys., Vol. 26, No. 6, 1657-9 (June, 1957).

Stationary perturbation theory has been used to calculate the Stark effect in the linear rigid rotor for the case in which the electric energy is large compared with the rotational energy. The method has been checked against the exact energy values, which were calculated for this purpose. Extension of the method to the Stark effect in the general rotor is possible. A.

539.132

8044. VIBRATIONAL SPECTRUM AND FORCE CONSTANTS OF DIBORON TETRACHLORIDE. D.E.Mann and L.Fano.
J. chem. Phys., Vol. 26, No. 6, 1665-70 (June, 1957).

The infrared spectrum of gaseous diboron tetrachloride (B_2Cl_4) and the Raman spectrum of the liquid are analysed. The molecular symmetry is shown to be V_d, in accord with the electron diffraction result for the vapour. A complete vibrational assignment is given. The fundamentals are (in cm^{-1}): 1131, 401, 225 in a_1; 730, 291 in b_2; 917, 617, 180 in e. A normal coordinate analysis, based on a Urey–Bradley potential function and a least-squares method of force constant adjustment, is used to establish the assignment. With the aid of the third-law entropy, the barrier restricting internal rotation about the B–B single bond is fixed at 1700 ± 600 cal/mole. A.

539.132

8045. CALCULATION OF ENERGY LEVELS FOR INTERNAL TORSION AND OVER-ALL ROTATION. II. CH_3CHO TYPE MOLECULES; ACETALDEHYDE SPECTRA. R.W.Kilb, C.C.Lin and E.B.Wilson,Jr.
J. chem. Phys., Vol. 26, No. 6, 1695-703 (June, 1957).

For Pt I see Abstr. 2938 (1955). Methods are described for the calculation of energy levels for the over-all rotation and internal torsion of molecules with a plane of symmetry and one symmetric internal rotor. Typical examples are CH_3CHO, CH_3SiH_2D and CH_3OH. Analysis of the microwave spectra of CH_3CHO, CD_3CDO, CD_3CHO, CH_2DCHO, CHD_2CHO, $C^{13}H_3CHO$, $CH_3C^{13}HO$, $C^{13}H_3C^{13}HO$ and CH_3CHO^{18} yields V_3 = 1162, 1151, 1143 ± 30 cal and $V_6 < 100$ cal, respectively, for the first three isotopic species, where the barrier to internal rotation is $V = V_3(1 - \cos 3\alpha)/2 + V_6(1 - \cos 6\alpha)/2$. The aldehyde oxygen was found to be opposite one of the methyl hydrogens in the equilibrium orientation of the methyl group. The measured moments of inertia of the nine isotopic species lead to a structure with the parameters:

Methyl group: C–H = 1.086A C–D = 1.088 H–C–H = 108°16'
D–C–D = 108°32' C–C = 1.501.
Aldehyde: C–H = 1.114 C–O = 1.216 C–C–H = 117°29'
C–C–O = 123°55'.

The Stark effect gave a dipole moment of 2.69 Debye. A.

539.132

8046. NORMAL COORDINATE ANALYSIS OF HALOGENATED ETHYLENES. I. GENERAL METHODS. D.E.Mann, T.Shimanouchi, J.H.Meal and L.Fano.
J. chem. Phys., Vol. 27, No. 1, 43-51 (July, 1957).

Methods and detailed algebraic expressions are given for the normal-coordinate analysis of ethylenic molecules. A force field of the Urey–Bradley type is used for the planar vibrations, and a simple valence-type potential function is applied to the nonplanar motions. The force constants established for the molecules with V_h symmetry are to be used with only linear interpolation and no further adjustment to calculate the fundamental frequencies and modes of all the remaining, less symmetrical ethylenes. For the V_h molecules the vibrational secular equations are set up in the customary GF matrix fashion. The other ethylenes require a somewhat different form which is more readily adapted to calculation by an electronic digital computer. In order that the force constants determined for the V_h molecules be as good as possible a method is given for their adjustment by a least-squaring process. A.

539.132

8047. NORMAL COORDINATE ANALYSIS OF HALOGENATED ETHYLENES. II. PERHALOGENATED ETHYLENES. D.E.Mann, L.Fano, J.H.Meal and T.Shimanouchi.
J. chem. Phys., Vol. 27, No. 1, 51-9 (July, 1957).

The methods described in the preceding abstract have been applied to the normal coordinate analysis of the fundamental vibrations of 27 perhalogenated ethylenes which contain F, Cl, or Br. Force constants for the planar modes of the key molecules, C_2F_4, C_2Cl_4, and C_2Br_4, have been obtained by an adjustment procedure based on the method of least squares. The agreement between the calculated and observed fundamentals is quite good. The constants established for the key molecules were then used, either directly or with a simple interpolation scheme, to calculate the fundamentals of the remaining 24 ethylenes. Comparisons with experimental results have been made where possible and indicate good agreement for the out-of-plane as well as in-plane vibrations. The planar normal modes of C_2F_4, C_2Cl_4, and the 5 fluorochloroethylenes are depicted. A.

539.132 : 535.343

8048. INTERNAL BARRIER OF PROPYLENE OXIDE FROM THE MICROWAVE SPECTRUM. I. J.D.Swalen and D.R.Herschbach.
J. chem. Phys., Vol. 27, No. 1, 100-8 (July, 1957).

In order to study the effects of hindered internal rotation of a methyl group for a high barrier case, the microwave spectrum of propylene oxide has been observed. Rotational transitions have been assigned up to J = 30 in the ground torsional state and to J = 10 in the first excited torsional state. The structure of the molecule was partially determined by combining the rotational constants derived from the spectrum with the known structure of ethylene oxide. From Stark effect measurements, the dipole moment was determined to be 2.00 ± 0.02 debye. The theory of the interaction of internal rotation with over-all rotation is discussed, including the necessary extension of the theory of Wilson, Lin, and Lide (Abstr. 2938/1955) for a molecule having no symmetry. Because the tunnel effect splits each torsional state into two levels, the rotational lines appear as doublets. The three-fold barrier hindering internal rotation of the methyl group is fitted to the doublet separations. For the ground state, the splitting of the lines was observed only for high J rotational transitions. A barrier of 2710 cal/mole was obtained. For the first excited torsional state, the splittings are about fifty times larger, and are observable for low J transitions. These yield a barrier of 2560 cal/mole. The causes of this apparent difference in barrier height and the errors in the method are discussed. A.

539.132 : 539.133 : 535.343

8049. MICROWAVE SPECTRUM, STRUCTURE, AND INTERNAL BARRIER OF METHYL SILANE. R.W.Kilb and L.Pierce.
J. chem. Phys., Vol. 27, No. 1, 108-12 (July, 1957).

The microwave spectrum of methyl silane has been reinvestigated. Seven symmetric top and ten asymmetric top isotopic species have been studied. These molecules, together with the six symmetric tops studied by Lide and Coles, yield a total of thirty-three rotational constants. A least-squares analysis of these constants gave the following structural parameters:

r_{SiC} = 1.8668 ± 0.0005 A, r_{CH} = 1.093 ± 0.005 A,
r_{SiH} = 1.485 ± 0.005 A, $\angle HCH$ = 107° 40' ± 30',
$\angle HSiH$ = 108° 15' ± 30'.

Analysis of the spectra of the isotopic species $CH_2D–SiH_2D$ and $CH_2D–SiHD_2$ shows conclusively that methyl silane in its equilibrium configuration has the methyl group staggered with respect to the silyl group. Certain transitions in the asymmetric top isotopic species, e.g. CH_3SiH_2D, are split into doublets because of coupling of over-all and internal rotation. These splittings were used to determine the barrier to internal rotation. The form of the potential hindering internal rotation was taken to be $V = \frac{1}{2}V_3(1 - \cos 3\alpha) + \frac{1}{2}V_6(1 - \cos 6\alpha)$, giving the result V_3 = 1700 ± 100 cal, $V_6 \sim 0–150$ cal. This is in reasonable agreement with the result of Kivelson's analysis of the J = 0 → 1 torsional satellites of $CH_3–SiH_3$. A.

539.13

8050. AN ITERATION METHOD FOR THE STRUCTURAL ASSIGNMENT OF MOLECULAR VIBRATION SPECTRA. E.Schmid
Naturwissenschaften, Vol. 44, No. 2, 30 (1957). In German.

Outlines a method of successive approximation for the calculation of the vibration frequencies from the various force constants. It will be described more fully elsewhere and applied to naphthalene. G.F.Lothian

539.13

8051. QUANTUM-MECHANICAL CALCULATION OF THE POTENTIAL BARRIER FOR INVERSION OF THE PHOSPHINE MOLECULE. M.Simonetta and A.Vaciago.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 587-91 (March, 1957). In Italian.

539.13

8052. PI-ELECTRON STRUCTURE OF BUTADIENE. R.S.Berry
J. chem. Phys., Vol. 26, No. 6, 1660-4 (June, 1957).

The spectrum and structure of butadiene have been considered by application of several nonempirical methods to the problem of the energy levels of the π-electron system. Six spatial configurations

of the nuclei have been treated, of which three correspond to the trans- form of the molecule and three, cis. The methods used include the use of antisymmetrized molecular orbitals with and without configuration interaction, electron-pair bonds, a model based on two neighbouring vinyl radicals, and the method of atoms in molecules as applied to the preceding techniques. A comparison of the results given by the different theories permits an evaluation of the theories, at least in the case of unsaturation electrons. A.

539.132 : 535.343

8053. ELECTRONIC SPECTRA OF THE TRIARYLMETHYL RADICALS. J.N.Murrell.
J. chem. Phys., Vol. 26, No. 6, 1738-41 (July, 1957).

The doublet electronic states of the triarylmethyl radicals are expanded in terms of functions describing states in which the "non-bonding" orbital is localized on the central carbon atom. This basic set of functions can be divided into three classes: those that correspond to singlet states of the aryl groups, those that correspond to triplet states of the aryl groups, and states in which an electron has been transferred to or removed from the central carbon atom. The spectrum of the triphenylmethyl radical is interpreted in this way. It is shown that the lowest band at 2.41 eV, although weak, arises from a symmetry allowed transition to a state of E symmetry (in the group D_3). There are several states which can contribute to the first intense band, there being two main regions of absorption. Both the energies and relative intensities of the predicted near ultraviolet bands agree well with experiment. A.

539.132

8054. THEORETICAL ELECTRONIC SPECTRUM OF THE ALLYL SYSTEM. H.D.Hunt, D.L.Peterson and W.T.Simpson.
J. chem. Phys., Vol. 27, No. 1, 20-3 (July, 1957).

Properties of π electrons in allyl anion, cation, and radical are calculated by including interaction between antisymmetrized products of molecular orbital functions. Detailed results in the form of energies and orbital composition of π-electron state functions for the anion as well as transition intensities and energies for all three molecules, including and excluding configurational interaction, are presented. The extent to which a valence bond type wave-function resembles an obtained state function is investigated by the computation of overlaps between the two functions. The overlaps and energies of various valence bond type functions are presented and suggest greater applicability of the valence bond approach in the case of the neutral radical compared to that of the ions. A.

539.132 : 535.371

OBSERVATION OF THE RELATIVE POLARIZATIONS OF ELECTRONIC TRANSITIONS. See Abstr. 7772

539.132

8055. ON THE PARAMAGNETIC RESONANCE SPECTRUM OF TRIPHENYLMETHYL. P.Brovetto and S.Ferroni.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 142-53 (Jan., 1957).

The hyperfine structure spectrum is deduced using the Slater–Pauling theory. The agreement with the existing experimental data is satisfactory. The usefulness of paramagnetic resonance measurements as an investigation method in valence theory is stressed. A.

539.132

8056. PROTON MAGNETIC RESONANCE SPECTRA OF SOME ALKYL NITRITES. L.H.Piette, J.D.Ray and R.A.Ogg, Jr.
J. chem. Phys., Vol. 26, No. 5, 1341-2 (May, 1957).

Proton magnetic resonance studies were used to indicate the existence of cis–trans isomers of alkyl nitrites near their melting points. At 21° C the interconversion was too rapid to measure but the lifetimes are $\gg 0.005$ sec at $-60°$ C for CH_3ONO. For the methyl ester the trans form predominates whereas for the ethyl and n-propyl esters the cis form is present in greater amounts. D.H.Whiffen

539.132

8057. FREE RADICAL FROM PERINAPHTHENE.
P.B.Sogo, M.Nakazaki and M.Calvin.
J. chem. Phys., Vol. 26, No. 5, 1343-5 (May, 1957).

A free radical formed from perinaphthene in CCl_4 on standing is detected by its electron spin resonance spectrum. This shows the electron coupling to six protons with 7.3 Oe and three others with 2.2 Oe. D.H.Whiffen

539.132

8058. DIMERIZATION OF SOLID GROUP IIIB TRIHALIDES. III. BROMINE, GALLIUM AND INDIUM QUADRUPOLE RESONANCES IN $GaBr_3$, GaI_3, AND InI_3.
R.G.Barnes, S.L.Segel, P.J.Bray and P.A.Casabella.
J. chem. Phys., Vol. 26, No. 5, 1345-6 (May, 1957).

For Pt II, see Abstr. 2493 (1957). In $GaBr_3$ the Br quadrupole resonances have been detected at 100 to 170 Mc/s and the Ga^{69} resonance at 26.494 Mc/s compared with 21.441 Mc/s in GaI_3 in both of which the traces indicate a close doublet. For InI_3 the spectrum indicates a coupling constant of 320.41 ± 0.15 Mc/s and an asymmetry of $69.0 \pm 0.2\%$; this large asymmetry makes $|\Delta m| = 2$ allowed transitions and the $\pm 7/2 \leftrightarrow \pm 3/2$ transition was observed at 63.2 Mc/s. D.H.Whiffen

539.132

8059. PROTON MAGNETIC RESONANCE OF SIMPLE AMINO ACIDS AND DIPEPTIDES IN AQUEOUS SOLUTION.
M.Takeda and O.Jardetzky.
J. chem. Phys., Vol. 26, No. 5, 1346-7 (May, 1957).

539.132

8060. NUCLEAR SPIN–SPIN COUPLING IN HYDROCARBONS.
E.Aihara.
J. chem. Phys., Vol. 26, No. 5, 1347-8 (May, 1957).

A theoretical account of spin–spin couplings in hydrocarbons using a perturbation theory based on direct hydrogen–hydrogen bonding shows that the cross term between the wave-function for this bond and for the normal bonding pattern gives the largest contribution to the spin–spin coupling and is of the observed order of magnitude. D.H.Whiffen

539.132

8061. PROTON RESONANCE OF FLUOROBENZENE IN THE EARTH'S MAGNETIC FIELD. D.F.Elliott and R.T.Schumacher.
J. chem. Phys., Vol. 26, No. 5, 1350 (May, 1957).

Protons in fluorobenzene are polarized with 500 gauss applied perpendicular to the earth's magnetic field and after removal of the polarizing field the 2300 c/s proton precession frequency is observed. It has a beat frequency of 5.8 ± 0.2 c/s superimposed on the exponential decay and this frequency is the mean H–F spin–spin coupling. D.H.Whiffen

539.132

8062. ELECTRON SPIN RESONANCE SPECTRUM OF DIBENZENE CHROMIUM CATION. R.D.Feltham, P.Sogo and M.Calvin.
J. chem. Phys., Vol. 26, No. 5, 1354-5 (May, 1957).

Electron resonance was observed in $Cr(C_6H_6)_2^+$ at 9.3 kMc/s with $g = 1.98 \pm 0.01$ and a fine structure with spacing 3.5 Oe due to coupling with the protons. D.H.Whiffen

539.132

8063. PREPARATION AND PROTON MAGNETIC RESONANCE STUDIES OF ANHYDROUS AMMONIA. R.A.Ogg, Jr and J.D.Ray.
J. chem. Phys., Vol. 26, No. 6, 1515-16 (June, 1957).

Comparison of high-resolution proton magnetic resonance spectra of anhydrous $N^{14}H_3$ and $N^{15}H_3$ (99.8% N^{15}) leads to the conclusion that the line width in $N^{14}H_3$ is due to quadrupole relaxation. A new method of preparation of anhydrous, sodium-free ammonia is described. The natural abundance of $N^{15}H_3$ in $N^{14}H_3$ is shown to be observable by magnetic resonance technique. A.

539.132

8064. ELECTRONIC STRUCTURE OF SODIUM–AMMONIA SOLUTIONS BY NUCLEAR MAGNETIC RESONANCE.
H.M.McConnell and C.H.Holm.
J. chem. Phys., Vol. 26, No. 6, 1517-22 (June, 1957).

Knight shifts (ΔH) of the N^{14} and Na^{23} nuclear magnetic resonances have been observed in liquid sodium–ammonia solutions at 7000 gauss as a function of the mole ratio $R = (\text{moles } NH_3)/(\text{moles Na})$ for $10 \sim< R \sim< 1000$. The Knight shifts decrease with increasing R and for $R \cong 10$, $\Delta H(N^{14}) \cong 4$, $\Delta H(Na^{23}) \cong 1$ gauss. The experimental results in these variable composition solutions are conveniently discussed in terms of $P(N^{14})$ and $P(Na^{23})$, the average hyperfine contact densities of N^{14} and Na^{23} nuclei at an unpaired electron. $P(N^{14})$ and $P(Na^{23})$ were estimated from K–NH_3 paramagnetic susceptibility data and the ΔH's. For $50 < R < 400$, $P(Na^{23}) = 5\text{-}3 \times 10^{-3}\ P^0(Na^{23})$ where $P^0(Na^{23})$ is the contact density in an isolated sodium atom. In this concentration range it is concluded that the odd electrons move in highly expanded orbitals about Na^+ ions similar to those appropriate to tetrahedrally bonded P^+ ions in P-doped silicon where a similar reduction in the contact hyperfine density is found. Marked electron condensation on

Na^+ ions occurs at $R \sim < 50$ where $P(Na^{23})$ and the electrical conductivity increase rapidly. $P(N^{14}) \cong 0.1\ P^0(N^{14})$ and is independent of R. H^1 Knight shifts were too small to detect. A.

539.132

8065. MEDIUM EFFECTS IN NUCLEAR MAGNETIC RESONANCE SPECTRA OF LIQUIDS. II. SIMPLE ALIPHATIC MOLECULES.
A.A.Bothner-By and R.E.Glick.
J. chem. Phys., Vol. 26, No. 6, 1647-50 (June, 1957).

The positions of resonance lines in the proton magnetic resonance spectra of many simple aliphatic compounds in liquid media are given as a function of medium susceptibility by the equation $\mathcal{H} = s_i\mathcal{H}_i^0(1-2.6K)$. This behaviour is compared with that theoretically expected and some possible explanations for the non-agreement are discussed. A.

539.132

8066. MEDIUM EFFECTS IN THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF LIQUIDS. III. AROMATICS.
A.A.Bothner-By and R.E.Glick.
J. chem. Phys., Vol. 26, 1651-4 (June, 1957).

For Pt II, see preceding abstract. The simple relationship between proton resonance line position and sample volume susceptibility applicable to mixtures of simple aliphatic compounds does not hold for mixtures containing an aromatic compound as a component. The departure from regular behaviour has been measured in a number of cases, and a possible model explaining the observations is proposed. A.

539.132

8067. QUADRUPOLE INTERACTION OF NUCLEI WITH CONDUCTION ELECTRONS. A.H.Mitchell.
J. chem. Phys., Vol. 26, No. 6, 1714-17 (June, 1957).

The nuclear spin–lattice relaxation time in metals is calculated taking into account the following three interactions between the nuclei and the conductions electrons: (1) the usual contact part of the hyperfine interaction, which is the dominant mechanism; (2) the noncontact part of the hyperfine interaction; (3) the quadrupole interaction for nuclei of spin $I \geq 1$. It is found that the latter two interactions are of the same order of magnitude. If the electronic wave-function of the Fermi surface has a p-wave component comparable with its s-wave component, these two mechanisms may appreciably shorten the relaxation time as calculated using only the contact part of the hyperfine interaction. A.

539.132

8068. NUCLEAR QUADRUPOLE INTERACTION IN BORON COMPOUNDS. T.P.Das.
J. chem. Phys., Vol. 27, No. 1, 1-10 (July, 1957).

The quadrupole coupling constants of B^{11} in some boron compounds are investigated in detail. A Townes–Dailey type of interpretation for boron trimethyl gives better agreement with experiment than a detailed molecular orbital calculation, but it is pointed out that this agreement is to be regarded as fortuitous. It is concluded that if localized LCAOMO functions are formed from undistorted atomic orbitals to describe a bond, they lead to an underestimation of the field-gradient at the nucleus due to the electrons. For borine carbonyl, an estimation of the ionic character of the BC bond is made from the observed quadrupole coupling constant of B^{11}. With this estimate, the dipole moment associated with the BH_3 group is obtained from the observed dipole moment of the whole molecule. The dipole moment of the BH_3 group is also calculated using localized LCAOMO's for the BH bonds. This calculation gives the correct sign of the observed dipole moment, but overestimates its magnitude. Some comments are made on the quadrupole interaction tensor for B^{11} in kernite using a molecular orbital approach. A.

539.132

8069. ANALYSIS OF SPIN–SPIN INTERACTION IN THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF SYMMETRICAL MOLECULES. E.B.Wilson, Jr.
J. chem. Phys., Vol. 27, No. 1, 60-8 (July, 1957).

Some techniques are given for utilizing molecular symmetry in setting up the equations for spin–spin coupling in molecules in the liquid state. Applications of group theory to factoring the secular equation, determining selection rules, etc. are similar to those developed for the problem of molecular vibrations. Sym-trifluorobenzene is used to illustrate the procedures. A.

539.132 : 535.343

8070. BONDING IN COPPER (II) CHELATES: SOLVENT EFFECT IN THEIR VISIBLE ABSORPTION SPECTRA.
R.L.Belford, M.Calvin and G.Belford.
J. chem. Phys., Vol. 26, No. 5, 1165-74 (May, 1957).

Absorption spectra, in the visible red and near infrared, are reported for solutions of bis-acetylacetono-Cu (II) and its 3-ethyl variant in various media. The spectra could arise from a set of three Gaussian components whose positions and intensities are shown to depend primarily upon solvent basicity. These component bands are identified with three $3d^1$—$3d^1$ transitions predicted from crystal field and molecular orbital theories. The behaviour of these bands upon alteration of solvent and of chelate ring substituents appears consistent with the postulated that π- bonding changes are energetically of less importance than changes in crystal field splitting and in σ bonding. A.

539.132

8071. DISTRIBUTION OF ELECTRONS IN THE WATER MOLECULE. K.E.Banyard and N.H.March.
J. chem. Phys., Vol. 26, No. 6, 1416-20 (June, 1957).

The electron distribution in H_2O is examined using the wave-functions of Ellison and Shull (E.S.) and the density averaged over all orientations about the O nucleus is computed. This is compared with that calculated from the simple central field wave-functions used previously by the authors in the interpretation of X-ray scattering results, and there is good agreement between these densities. In addition to the s term in the expansion of the E.S. density in spherical harmonics, the p term is also exhibited explicitly; it is this which determines the dipole moment of the molecule. In the second part of the paper a general method is developed for the calculation of the X-ray scattering by a gas of nonspherical molecules. Using this formulation together with the E.S. density for H_2O it is shown that the p term has only a very small effect on the scattering factor. The results using the E.S. density are in good agreement with those obtained previously and with experiment. A.

539.132

8072. DERIVATION OF AN INTERNUCLEAR POTENTIAL FUNCTION FROM A QUANTUM MECHANICAL MODEL.
E.R.Lippincott.
J. chem. Phys., Vol. 26, No. 6, 1678-85 (June, 1957).

A simple quantum-mechanical model of bond formation is presented which allows the derivation of an internuclear potential function of the form $V = -D_e \exp(-n\Delta R^2/2R)$, where $n = k_e R_e/D_e$. The method makes use of a delta function model whereby bond formation is described by the shifting of atomic delta functions into molecular delta functions. The predicted results for H_2^+ are nearly exact for all bond properties while the results for H_2 are more accurate than those for all but the most elaborate methods used previously. The model has also been used to calculate values of R_e, D_e, ω_e and $\omega_e x_e$ for a large number of stable excited states of H_2 with good results. Advantages of the method are that the same form for the internuclear potential function is obtained for multi-electronic bonds as for one and two electron bonds, and that multi-electronic bond systems can be handled by one-dimensional methods. Theoretical values for the parameter, n, for multi-electronic bonds are calculated which agree well with values obtained from experimental data. A disadvantage of the method is that the problem of bond formation has been oversimplified by using arbitrary assumptions. A.

539.13

8073. A STUDY OF THE ELECTRONIC GROUND STATE OF THE AMMONIA MOLECULE. H.Kaplan.
J. chem. Phys., Vol. 26, No. 6, 1704-13 (June, 1957).

The electronic structure of the ground state of the ammonia molecule has been calculated in the SCF LCAO MO approximation for two sets of internuclear separations: the experimentally observed values and a symmetric planar arrangement. The effect of limited configuration interaction on these results has also been investigated. The atomic orbitals used include 1s, 2s, and 2p nitrogen orbitals and 1s hydrogen orbitals, the nitrogen orbitals being the Hartree and Hartree solutions of the Hartree–Fock problem for the neutral nitrogen atom and the hydrogen orbitals being the standard free atom functions. All integrals were calculated using the method of Barnett and Coulson and Lundqvist and Löwdin, the only approximation involved being the mathematical one of terminating infinite series. The significance of the results is discussed, and calculation of the binding energy, the dipole moment, and other molecular properties are compared with experiment.

539.132

8074. MOLECULAR ORBITAL STUDY OF THE PORPHYRINS. G.R.Seely.
J. chem. Phys., Vol. 27, No. 1, 125-33 (July, 1957).

An LCAO molecular orbital calculation has been carried out for models of porphin and its hydrogenated derivatives, chlorin, α and β tetrahydroporphin, and hexahydroporphin. Application of the results to the spectra of these compounds has provided a consistent interpretation in terms of relative energies of the two highest filled molecular orbitals. Comparison is made largely with the observed spectra of zinc tetraphenylporphyrins. The calculation confirms the proposed structural assignments for α and β tetrahydroporphins. The use of Tschebycheff polynomials in solving secular equations is described. A.

539.132

8075. THE BOND ORBITAL APPROXIMATION FOR π-ELECTRON SYSTEM IN BENZENE. E.Aihara and K.Niira.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1261-4 (Dec., 1956).

The electronic energies of π-electron system in benzene molecule have been calculated by the bond orbital (BO) method for singlet states. Configuration interactions (CI) have not been taken into account. All the levels other than $^1B_{2u}$ and $^1E_{2g}$ calculated by the present method are higher than the levels calculated by the MO method without CI. In the MO method, however, the order of levels is changed and coincides with the observed order, by including CI. In the BO method the order of levels would not be changed by including CI, since the BO method without CI already gives the correct order. A.

539.132

8076. DISSOCIATION ENERGIES OF Cu_2, Ag_2, AND Au_2. P.Schissel.
J. chem. Phys., Vol. 26, No. 5, 1276-80 (May, 1957).

A combination of a Knudsen cell and mass spectrometric analysis of the effusing vapour has been used to study the gaseous species in equilibrium with Cu(l), Ag(l) and Au(l). From the observed ratios of monomer to dimer the following dissociation energies have been calculated: $D_0^\circ(Cu_2) = 2.21 \pm 0.11$ eV; $D_0^\circ(Ag_2) = 1.78 \pm 0.10$ eV; $D_0^\circ(Au_2) = 2.30 \pm 0.12$ eV. Upper limits for the abundances of the trimers and tetramers are given. Combining the vapour pressure ratios with accepted values for the heats of sublimation of the monomers, the following heats of sublimation for the dimers at 0°K are obtained: $L(Cu_2) = 110 \pm 4$ kcal; $L(Ag_2) = 95 \pm 4$ kcal; $L(Au_2) = 118 \pm 5$ kcal. A.

539.132

8077. ELECTRONIC SPECTRUM AND DISSOCIATION ENERGY OF FLUORINE. A.L.G.Rees.
J. chem. Phys., Vol. 26, No. 6, 1567-71 (June, 1957).

The continuous absorption spectrum of molecular fluorine and the Raman displacement for the $0 \rightarrow 1$ vibrational transition have been used to compute the potential energy curve for the repulsive $^1\Pi_u$ state dissociating to two normal fluorine atoms. This curve is consistent with a value of 37.1 ± 0.85 kcal mole^{-1} for the dissociation energy of the ground state. A weak absorption, attributed, on the grounds of location and intensity, to $^3\Pi_{o+u} \leftarrow {}^1\Sigma_g^+$, has been shown to occur in the long wavelength region of the main absorption and a segment of the potential energy curve for $^3\Pi_{o+u}$ has been deduced. Absorption curves, calculated from the potential energy curves and the ground-state anharmonic eigenfunctions, fit the observed data satisfactorily. A.

539.133

8078. MAGNETIC MOMENT OF IRON IONS. S.Broersma.
J. chem. Phys., Vol. 26, No. 6, 1405-6 (June, 1957).

Proton magnetic relaxation rates were measured in solutions of ferric perchlorate with stoichiometric concentrations ranging from 10^{-1} to 4×10^{-5} molar, at pH's between 0 and 12. It is found that the magnetic moments of $Fe(OH)_2(+1)$ and $Fe(OH)(+2)$ are equal to that of Fe(+3) (5.9 Bohr magnetons), while $Fe_2(OH)_2$ (+4) is diamagnetic. The experimental results suggest that the equilibrium constant for the formation of $Fe_2(OH)_2$ (+4) from Fe (+3) is 1×10^{-2} moles/l. at 20°C. A.

539.133

8079. ROTATIONAL MAGNETIC MOMENTS OF Li^6F AND Li^7F. A.M.Russell.
Phys. Rev., Vol. 106, No. 5, 1100 (June 1, 1957).

Rotational magnetic moments of Li^6F and Li^7F have been calculated by the ion-pair approximation and compared with results of measurements. Similar calculations for alkali and hydrogen halides show that the sign of the moment depends on the relative masses of the ions. R.C.Seymour

539.133

8080. SEMITOPOLOGICAL APPROACH TO BORON-HYDRIDE STRUCTURES. R.E.Dickerson and W.N.Lipscomb.
J. chem. Phys., Vol. 27, No. 1, 212-17 (July, 1957).

A semitopological approach to the structures of boron hydrides is discussed in detail, as an extension of the equations of orbital and electron balance derived by Eberhardt, Crawford, and Lipscomb (Abstr. 8503/1954). This consistent set of principles gives the presently known boron hydrides whose frameworks are icosahedral fragments, and predicts (1) the hydrogen arrangement in B_6H_{10}, (2) that a stable B_8 hydride will probably be either B_8H_{12} or B_8H_{14}, (3) B_9H_{13} should not exist, and (4) that no B_7 hydride should exist. A.

539.133 : 535.343

8081. MICROWAVE SPECTRUM AND MOLECULAR STRUCTURE OF BROMINE TRIFLUORIDE. D.W.Magnuson.
J. chem. Phys., Vol. 27, No. 1, 223-6 (July, 1957).

The moments of inertia and quadrupole coupling coefficients of both $Br^{79}F_3$ and $Br^{81}F_3$ were determined from a number of microwave transitions. From the moments of inertia the bromine trifluoride molecule was found to have a planar distorted –T structure with one short, 1.721 A, and two long, 1.810 A Br—F bonds. The FBrF' angle was found to be 86° 12.6'. A.

539.133 : 535.343

STRUCTURE OF DIFLUOROSILANE. See Abstr. 7757

539.133 : 548.74

8082. STRUCTURE OF THE $CH_2{=}CH-C{\equiv}N$ MOLECULE [STUDIED] BY ELECTRON DIFFRACTION.
M.Rouault and C.St-Arnaud.
Canad. J. Phys., Vol. 35, No. 4, 504-6 (April, 1957). In French.

The planar structure and molecular parameters proposed by Wilcox (Abstr. 4373/1954) are confirmed. The C=C bond length is 1.38 ± 0.01 A. G.Allen

539.133

8083. PROTON AND NITROGEN MAGNETIC RESONANCE SPECTRA AND STRUCTURE OF NITRAMIDE AND NITROURETHANE.
J.D.Ray and R.A.Ogg, Jr.
J. chem. Phys., Vol. 26, No. 6, 1452-4 (June, 1957).

Nuclear magnetic resonance spectra of both protons and N^{14} nuclei in nitrourethane and nitramide have been studied. Spectra are interpreted in terms of the structures $R{-}NHNO_2$ and H_2NNO_2 for nitrourethane and nitramide, respectively. Protons have been established as all being of amino type. A.

539.133 : 535.343

STRUCTURE OF TROPYLIUM ION. See Abstr. 7753

539.133

8084. STATISTICAL COMPUTATION OF MEAN DIMENSIONS OF POLYMER MOLECULES. IV.
F.T.Wall, L.A.Hiller, Jr and W.F.Atchison.
J. chem. Phys., Vol. 26, No. 6, 1742-9 (June, 1957).

For Pt III, see Abstr. 3909 (1956). In a further investigation of the nonintersecting random walk problem, two new types of random walks have been examined to determine the effect of the magnitude of the "excluded volume" on the limiting behaviour of the ratio, $\langle r_n^2 \rangle / n$, where $\langle r_n^2 \rangle$ is the mean square length of nonintersecting random walks of n steps. In two dimensions, $\langle r_n^2 \rangle / n$ normally diverges, but for walks in a right-left two-choice 90° lattice, for which exclusions are counted on odd steps only, the "excluded area" is reduced to such an extent that convergence of $\langle r_n^2 \rangle Av/n$ may occur. In three dimensions, $\langle r_n^2 \rangle / n$ may converge, but if random walks in a three-choice tetrahedral lattice are generated subject to the condition that walks cannot return to lattice points within unit distances from previously occupied sites, the "excluded volume" is sufficiently increased so that $\langle r_n^2 \rangle / n$ certainly diverges as $n \rightarrow \infty$. In addition to the above, the process for selecting the random numbers used to generate random walks has been re-examined more fully and has been found to be satisfactory. Values have also been examined for mean square lengths of failures which might result from backward steps. These distances agree with an empirical relationship found to hold for the other types of failures, thus providing further justification for an earlier theoretical interpretation of the nonintersecting random walk problem. A.

539.133

8085. IMPROVED STATISTICAL METHOD FOR COMPUTING MEAN DIMENSIONS OF POLYMER MOLECULES.
F.T.Wall, R.J.Rubin and L.M.Isaacson.
J. chem. Phys., Vol. 27, No. 1, 186-8 (July, 1957).

Further work on the dimensions of coiling type polymer molecules has been carried out with an electronic digital computer using

nonintersecting random walks as molecular models. A modified method has been devised which significantly reduces the serious attrition of samples. The procedure, applied to walks in the two-choice square lattice, consists of adding strides of four steps instead of adding single steps one by one. The strides are so chosen that a valid statistical sample can be attained while eliminating most of the attrition attributable to closures of four-membered rings. The method shows promise of being applicable to problems of a more general nature. A.

ATOMS. NUCLEUS. ISOTOPES 539.15

539.15/.18

8086. ATOMIC PHYSICS. M.Born [Translated by J.Dougall and revised in collaboration with R.J.Blin-Stoyle].
Sixth edition. London and Glasgow: Blackie and Son (1957) 445 pp.

The new edition of this well-known university text-book has additional information on quantum electrodynamics, shell and collective models of the nucleus, particle accelerators, resonance methods of investigating atomic and nuclear properties.

539.152.1 : 539.172

8087. NUCLEAR PHYSICS. V.F.Weisskopf.
Rev. mod. Phys., Vol. 29, No. 2, 174-81 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). A review of nuclear structure and stability, with special reference to the Brueckner approach in terms of two-body forces between pairs of particles, includes a discussion of the momentum-dependent depth of the potential well and its experimental study. A three-stage nuclear reaction scheme is proposed with (i) an independent particle stage, (ii) a compound-system stage which includes the compound nucleus and events which cause absorption in the first stage, and (iii) a final stage. E.J.Burge

539.152.1 : 539.163.2

LEVELS IN RARE-EARTH NUCLEI. See Abstr. 7328, 7330

539.152.1

8088. ON THE SUMMATION RULE FOR B_p AND B_n. I.
K.C.Kar and A.Basu.
Indian J. theor. Phys., Vol. 3, No. 2, 35-76 (June, 1955).

The validity of the summation rule for B_p, B_n (Abstr. 5580/1955) has been proved up to atomic number $Z = 30$. Using this rule some doubtful B_p and B_n values have been corrected and several unknown B_p's and B_n's have been calculated in this region. A.

539.152.1

8089. ON THE SUMMATION RULE FOR B_p AND B_n. II.
K.C.Kar and A.Basu.
Indian J. theor. Phys., Vol. 3, No. 4, 125-42 (Dec., 1955).

Gives the calculation of nearly twenty unknown values of B_p and B_n in the region: $Z = 31$ to $Z = 38$, using the summation rule. A.

539.152.1

8090. EXACT-ENERGY SELF-CONSISTENT FIELD.
R.A.Kromhout.
Phys. Rev., Vol. 107, No. 1, 215-19 (July 1, 1957).

A self-consistent field Hamiltonian is constructed, for arbitrary pair interactions, which yields (in principle) an exact value for the energy of a chosen state of a system of N particles, as well as estimates for other states. The method for extending the formalism to interactions involving arbitrary numbers of particles is indicated and is straightforward. The method is carried out within the bound-state framework, and while motivated by the recent work of Bethe, results in a Hamiltonian somewhat different from his. An argument is presented which indicates that the independent-particle eigenfunctions of this Hamiltonian are "good" representations of the original N-body system. A discussion of the practicability of the computations is included. A.

539.152.1

8091. NUCLEON–NUCLEUS INTERACTION FROM THE STATISTICAL MODEL. W.E.Frahn.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 393-401 (Feb., 1957).

The statistical nuclear model with exchange forces leads to a non-local interaction between a nucleon and its neighbours in nuclear matter (Van Vleck potential). The implications of this interaction with regard to the modification of nuclear motion and to the energy dependence of the real parts of the optical model parameters are examined. Finally, a derivation of Van Vleck's potential is given from Brueckner's coherent model. A.

539.152.1

8092. ON COLLECTIVE ROTATIONAL MOTIONS OF NUCLEI.
R.S.Nataf.
Nuclear Physics, Vol. 2, No. 5, 497-525 (Jan., 1957). In French.

Bohr and Mottelson have forecast the rotational nuclear levels by their unified model in which collective motions (liquid drop) and individual motions (shell model) are taken together and coupled. Attempts have previously been made to derive this compound Hamiltonian from the Schrödinger one for the nucleus, by a method in which the collective variables are expressed in terms of the coordinates of the nucleons — and then taken as redundant variables. The author now derives from symmetry (indiscernibility of nucleons) and rotation invariance requirements the possible expressions, which contain as the simplest ones those given by Bohr. These coordinate transformations are studied and it is found that they do not lead to the well-known rotational levels. A.

539.152.1

8093. CALCULATIONS IN NUCLEAR SPECTROSCOPY WITH THE HARMONIC OSCILLATOR SHELL MODEL. R.Thieberger.
Nuclear Physics, Vol. 2, No. 5, 533-47 (Jan., 1957).

A summary of the results and methods in the use of harmonic oscillator wave-functions in nuclear spectroscopy is presented. A.

539.152.1

8094. NUCLEAR SHELL MODELS. J.H.D.Jensen.
Rev. mod. Phys., Vol. 29, No. 2, 182-5 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). A brief review of the history of the shell model concept and some of the more recent successes of this theory. J.W.G.Wignall

539.152.1

8095. COLLECTIVE MOTION IN THE NUCLEUS.
B.R.Mottelson.
Rev. mod. Phys., Vol. 29, No. 2, 186-90 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). Understanding of low-energy nuclear properties requires an analysis of the interplay between collective shape oscillations and independent particle degrees of freedom. Far from closed shells nuclei possess a nonspherical shape due to the polarizing effect of those nucleons outside the shells, and the lowest excitations are rotations. With the approach to a closed shell nuclear eccentricity and moment of inertia both decrease; at a point which may be still quite distant from the closed shell configuration the spherical shape becomes a stable equilibrium due to residual forces between nucleons; the whole nuclear coupling scheme now changes and the lowest excitations are quadrupole-type vibrations, whose frequency increases with further approach to the closed shell configuration. Finally, in the immediate neighbourhood of the closed shell these vibrational frequencies become comparable with the independent particle model and the collective model breaks down. J.W.Gardner

539.152.1

8096. ON EVEN-EVEN NUCLEI, CHARACTERIZED BY A 2+ SECOND EXCITED STATE. N.N.Delyagin and V.S.Shpinel'.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 373-4 (1957). In Russian.

Nuclei having the level scheme O+, 2+, 2+ all lie in intermediate regions between closed shells and the regions of large deformation. These levels may have either a character intermediate between the collective and individual particle models or a collective, but vibrational one. The 2+ to 2+ gamma-transition shows a regular increase with distance away from closed shells. G.E.Brown

539.152.

8097. VARIATION OF THE BINDING ENERGIES OF NEUTRONS AND PROTONS IN HEAVY NUCLEI. H.K.Raut.
Indian J. Phys., Vol. 30, No. 12, 611-19 (Dec., 1956).

The binding energy of the last neutron and of the last proton for different N–Z values has been calculated from Hg^{202} to Fm^{255} from current mass data. The variation of binding energy has been studied and graphs plotted throughout this range. It is observed that there are possibilities for the existence of magic numbers after 82 protons and 126 neutrons. A.

539.152.1 : 539.18

8098. ROLE OF THREE-PARTICLE FORCES IN THE THREE-BODY PROBLEM. É.V.Teodorovich and N.N.Kolesnikov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 392-3 (1957). In Russian.

Scattering of neutrons by deuterium is calculated, using the Schwinger variational method. It turns out to be impossible to get the right cross-section using the strengths of interaction needed to give the right binding energy for H^3 and saturation in heavy nuclei. G.E.Brown

539.152.1

8099. LEVY–KLEIN POTENTIAL OF PSEUDOSCALAR MESON THEORY AND NUCLEAR SATURATION. B.K.Kerimov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 377-9 (1957). In Russian.

It is shown that the requirements of saturation are not satisfied even with the addition of a three-body force of the Drell–Huang type (Abstr. 86/1954). G.E.Brown

539.152.1

8100. NUCLEAR RADIATION WIDTHS. A.G.W.Cameron.
Canad. J. Phys., Vol. 35, No. 5, 666-71 (May, 1957).

The total radiation widths of nuclear energy levels have been computed using the new level spacing formula of T.D.Newton. The only adjustable constant in this calculation is a normalizing factor, which was determined by comparison with observed radiation widths. The logarithmic average deviation of the observed radiation widths from the calculated values is then equal to a factor 1.37. Radiation widths computed for a series of nuclei close to the valley of beta stability at excitation energies corresponding to the energy release in neutron capture are presented. It is found that in heavy nuclei with large level spacings the radiation widths of electric dipole transitions to the ground state can exceed that computed from the above considerations. This accounts for the unusual nature of the radiative transitions in lead. A.

539.152.1

8101. NUCLEAR EXCITATION BY ELECTRONS. H.R.Robl.
Nuclear Physics, Vol. 2, No. 6, 641-50 (Feb., 1957). In German

The excitation of nuclei by electrons is considered as the inverse process to electron scattering in transitions of nuclei to states of lower energy. The calculation of the cross-sections does not make explicit use of nuclear matrix elements, but involves only mean life-times of the excited states. The cross-sections are given for magnetic and electric multipole transitions of arbitrary order. The total cross-sections for an electron energy of 10 mc^2 and for excitation energies between 0.2 and 5 mc^2 are given. A.

539.152.1

8102. TABLES OF CERTAIN CLEBSCH–GORDAN COEFFICIENTS AND OF MATRIX ELEMENTS OF P_2, P_2^2 AND P_2^3 BETWEEN SINGLE PARTICLE STATES [OF SPHEROIDAL NUCLEI]. K.Kumar.
Canad. J. Phys., Vol. 35, No. 3, 341-5 (March, 1957).

539.152.1

8103. ENERGY LEVELS OF Np^{237} POPULATED BY THE BETA DECAY OF U^{237}. J.O.Rasmussen, F.L.Canavan and J.M.Hollander.
Phys. Rev., Vol. 107, No. 1, 141-54 (July 1, 1957).

A spectroscopic investigation has been made of the radiations from U^{237} with magnetic 180° spectrographs and a double-focusing spectrometer, and with scintillation and coincidence spectrometers. Energy levels are identified at 0, 33.20, 59.57, 103.0, 267.5, 332.3, 368.5, and 370.9 keV, and spin and parity assignments are given for all the levels from the gamma-ray multipolarity and beta-decay information. Conversion-coefficient information is presented, and an anomaly in the electric-dipole conversion coefficients is discussed. A new rotational band with K = 1/2 is postulated, with base state at 332.3 keV. Correlations of the data with various aspects of the Bohr–Mottelson nuclear model are made, in the following categories: (1) energy-level spacings and moments of inertia; (2) gamma-ray relative intensities and the K-selection rules and branching-ratio rules; (3) correlations of spins and parities with the Nilsson numbers $(N,n_z\Lambda)$ of these states; (4) correlation of beta and gamma lifetimes with selection rules in the asymptotic quantum numbers. A.

539.152.1

8104. EXCITED STATES IN Co^{59} AND Fe^{56}.
M.Mazari, A.Sperduto and W.W.Buechner.
Phys. Rev., Vol. 107, No. 2, 365-67 (July 15, 1957).

The energy-level scheme of Co^{59} has been investigated through studies of inelastic proton scattering. An electrostatic accelerator and a high-resolution magnetic spectrograph were used. The region of excitation studied ranged from the ground state to 3.6 MeV, and in this region forty excited states were found. A number of alpha-particle groups were observed to result from the proton bombardment of cobalt targets, and these were identified as arising from the $Co^{59}(p,\alpha)Fe^{56}$ reaction. The ground-state Q-value for this reaction was measured as 3.242 ± 0.008 MeV. A.

539.152.1

8105. ON A METHOD OF DIRECT CALCULATION OF THE NUCLEON–NUCLEON INTERACTION HAMILTONIAN FROM EXPERIMENTAL VALUES OF THE LEVELS OF LIGHT NUCLEI.
Yu.M.Shirokov, V.V.Balashov and K.A.Tumanov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 167-8 (1957). In Russian.

The nuclear wave-functions are expanded in terms of simple harmonic oscillator functions. A very rough calculation for H^3, He^3 and He^4 is carried out in which only 1s functions are employed. G.E.Brown

539.152.1 : 539.152.2

8106. QUASIMAGNETIC INTERACTION OF THE NUCLEON SPIN WITH THE NUCLEAR ROTATION. D.F.Zaretskiĭ and A.V.Shut'ko.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 370-1 (1957). In Russian.

Nuclei with spin $-\frac{1}{2}$ can be considered as being in $^2\Sigma$-states, following the Hund scheme b. In lowest approximation, levels with total angular momenta $I = K \pm \frac{1}{2}$ are degenerate, but this degeneracy is removed by the interaction considered here. G.E.Brown

539.152.1 : 539.163.2

ENERGY LEVELS OF Hf^{177}. See Abstr. 7331

539.152.1 : 539.172.13 : 539.165.2

ENERGY LEVELS OF Tc^{95}. See Abstr. 7338

539.152.1 : 539.166.2

ENERGY LEVELS IN A^{36}, A^{38}, Ca^{40}. See Abstr. 7347

539.152.2

8107. DETERMINATION OF THE ELECTRIC QUADRUPOLE MOMENT OF THE Zn^{67} NUCLEUS THROUGH MEASUREMENT OF THE HIGH-FREQUENCY TRANSITIONS IN THE $4\,^3P_1$ STATE OF THE Zn^{67} ATOM. K.Böckmann, H.Krüger and E.Recknagel.
Naturwissenschaften, Vol. 44, No. 1, 7-8 (1957).

The F 7/2 to 5/2 and 5/2 to 3/2 transitions of the $4\,^3P_1$ state of Zn^{67}, I = 5/2, were detected at 2111.15 and 11 551.60 ± 0.15 Mc/s respectively, by observing the change of polarization properties of the $4\,^1S_0 - 4\,^3P_1$ fluorescence radiation at 3076 A. The magnetic splitting factor A = 609.0 ± 0.1 Mc/s and the quadrupole coupling B = −19.4 ± 0.1 Mc/s and the nuclear moment $Q = +0.18 \times 10^{-24}\,cm^2$. D.H.Whiffen

539.152.2

8108. SPINS OF THALLIUM-197, -198m, -199, AND -204 AND THE HYPERFINE-STRUCTURE SPLITTING OF THALLIUM-204.
G.O.Brink, J.C.Hubbs, W.A.Nierenberg and J.L.Worcester.
Phys. Rev., Vol. 107, No. 1, 189-95 (July 1, 1957).

The nuclear angular momenta of four isotopes of thallium and the hyperfine-structure splitting of Tl^{204} in the $^2P_{1/2}$ state have been measured by the atomic-beam magnetic resonance method. The results are: For 2.7 hr Tl^{197}, I = ½; for 1.8 hr Tl^{198m}, I = 7; for 7.2 hr Tl^{199}, I = ½; for 4.1 yr Tl^{204}, I = 2 and $\Delta\nu(^2P_{1/2}) = 732 \pm 5$ Mc/s. The neutron-deficient isotopes are produced by alpha-particle bombardment of gold in the Berkeley 60 in. cyclotron; Tl^{204} is produced by neutron activation of metallic thallium samples. A.

539.152.2 : 532.7

ANALYSIS OF HIGH-RESOLUTION N.M.R. SPECTRA. See Abstr. 7651

539.152.2 : 537.311.33

NUCLEAR MAGNETIC RESONANCE IN INDIUM ANTIMONIDE. See Abstr. 7903

539.153

8109. STARK EFFECT ON CESIUM-133 HYPERFINE STRUCTURE.
R.D.Haun,Jr and J.R.Zacharias.
Phys. Rev., Vol. 107, No. 1, 107-9 (July 1, 1957).

The change of the hyperfine-structure separation energy caused by an electric field has been measured in Cs^{133} by the atomic-beam magnetic-resonance method. The shift of the $(F = 4, m_F = 0) \leftrightarrow (F = 3, m_F = 0)$ transition frequency in the electric field $\mathcal{E}$ is given by $\Delta(\mathcal{E}) = -2.29 \times 10^{-6}(1 \pm 0.03)\mathcal{E}^2$ c/s, where $\mathcal{E}$ is in volts/cm. This number is 2.8 times the value predicted from the atomic polarizability measurements of Scheffers and Stark if a simplified theory which neglects hyperfine-structure perturbations of the ground-state wave-functions is used. A.

539.153

8110. DECAY OF THE TRIPLET P LEVELS ON NEON.
J.R.Dixon and F.A.Grant.
Phys. Rev., Vol. 107, No. 1, 118-24 (July 1, 1957).

The current and pressure dependence of the decay of the $^3P_0$ metastable level of neon was measured by using a light absorption method. The decay was found to be nonexponential and current dependent at normal excitation currents. At extremely low excitation

current, however, the $^3P_0$ decay becomes exponential and current independent. The mean lives associated with such exponential decays were measured as a function of pressure. The results are in agreement with the usual theoretical relation based on metastable destruction by diffusion to the container walls at low pressure and two-body collisions at high pressures. The pressure dependence of the $^3P_2$ level was also studied. It was found, as previously reported by Grant, that the experimental results for the pressure range from 2 to 20 mm of mercury, where diffusion loss is small, do not agree with the usual theoretical prediction. A.

539.153

8111. FINE STRUCTURE OF THE 2 ^{3}P AND 3 ^{3}P STATES IN HELIUM. I.Wieder and W.E.Lamb, Jr.
Phys. Rev., Vol. 107, No. 1, 125-34 (July 1, 1957).

The 2 $^3P_2$–2 $^3P_1$, 3 $^3P_1$–3 $^3P_0$ and 3 $^3P_2$–3 $^3P_1$ level separations in orthohelium are determined experimentally by extending previously developed microwave-optical techniques. Frequencies of 2291.72 ± ± 0.36 Mc/s, 8113.78 ± 0.22 Mc/s and 658.55 ± 0.15 Mc/s respectively are found for the above level separations. These results are to be compared with previous optical measurements of 2295 ± 21 Mc/s for 2 $^3P_2$–2 $^3P_1$, 7950 ± 600 Mc/s for 3 $^3P_1$–3 $^3P_0$, and a microwave-optical determination of 658 ± 1 Mc/s for 3 $^3P_2$–3 $^3P_1$. A.

539.153

8112. ELECTRON COLLISION PARTIAL CROSS SECTIONS FOR THE 1s-2s AND 1s-3s TRANSITIONS OF ATOMIC HYDROGEN. D.R.Bates and D.Miskelly.
Proc. Phys. Soc. A, Vol. 70, Pt 7, 539-42 (July, 1957).

Values of the q_l $l = 0, 1, 2, 3, 4$, and the total cross-section, Q, for the two transitions are presented, calculated on Born's approximation for various incident energies. It is apparent that the conservation theorem limits are not approached closely. Rapid convergence of the truncated series $Q_N = \sum_{l}^{N} q_l$ is established, the ratios $R_N = Q_N/Q$ being plotted as functions of $\Delta k = k_i - k_f$. The incident energies below which Q_N differs from Q by less than 5% and 10% are also tabulated. N.M.King

539.153.4

8113. SEARCH FOR A DISCRETE EXCITED TRIPLET STATE OF THE NEGATIVE HYDROGEN ION. G.R.Lowrey and R.D.Present.
Astrophys. J., Vol. 125, No. 2, 611 (March, 1957).

A treatment, similar to that of Hylleras for He, with an eight-term trial wave-function for the lowest triplet state of H^- gave an energy −0.9718 hcR (where h = Planck's constant, c = velocity of light, R = Rydberg's constant), which is above the ionization limit of −1 hcR. It is concluded that a stable triplet state of H^- cannot exist. D.H.Whiffen

539.153.4

8114. ASYMPTOTIC RELATIONS IN THE THOMAS–FERMI–DIRAC ATOM MODEL. J.J.Gilvarry.
J. chem. Phys., Vol. 27, No. 1, 150-4 (July, 1957).

Asymptotic solutions of the Thomas–Fermi–Dirac equation for the case where the atom radius is vanishingly small (Fermi–Dirac limit) are considered. The limiting situation is examined in which the atomic number vanishes for a constant value of the Thomas–Fermi pressure (without exchange). It is shown that the pressure with exchange from the Thomas–Fermi–Dirac model approaches a finite limit in this case. The results yield limit curves approached for vanishing atomic number, by curves at constant atomic number of the pressure and other thermodynamic quantities with exchange, as a function of the pressure without exchange. The theoretical conclusions are confirmed by numerical data given by others and obtained directly by solution of the Thomas–Fermi–Dirac equation. A.

539.153.4 : 536.7

8115. THERMODYNAMIC FUNCTIONS ON THE GENERALIZED THOMAS–FERMI–DIRAC THEORY. J.J.Gilvarry.
Phys. Rev., Vol. 107, No. 1, 33-40 (July 1, 1957).

The generalization of the Thomas–Fermi–Dirac atom model to include a temperature perturbation of first order is considered, as formulated from a variational procedure by Umeda and Tomishima. Initially, no restriction is imposed on the shape of the atom's boundary surface. It is shown that the model yields direct analogues for the case with exchange of relations given by Brachman for the Helmholtz function and the entropy in the extended Thomas–Fermi atom model for arbitrary temperature. The virial theorem is derived for an atom of general shape on the model in question, by means of which one obtains analogues of expressions for the heat capacity of the Thomas–Fermi atom. These results yield a set of theorems involving the energy which are direct analogues of ones in the Thomas–Fermi case at arbitrary temperature, and represent a generalization of Milne's theorem, which expresses the energy of an atom at zero temperature in terms of boundary and initial parameter derived from the solution of the Thomas–Fermi equation. The entropy of the temperature-perturbed atom is obtained in terms of a quadrature on the corresponding solution of the Thomas–Fermi–Dirac equation for zero temperature, in a form corresponding to a result of Mayer in the Thomas–Fermi case. The following analogue of Mayer's theorem is established: every thermodynamic function of a Thomas–Fermi–Dirac atom in the first-order temperature-perturbed case can be expressed in terms of quadratures on the corresponding solution of the Thomas–Fermi–Dirac equation for zero temperature. Results obtained are specialized to a spherically symmetric atom and explicit expressions for the temperature perturbations in thermodynamic functions for this case are given in terms of quadratures on the corresponding unperturbed solution of the Thomas–Fermi–Dirac equation. It is argued that the results obtained for the analogues of the theorems of Brachman and Milne are probably exact for arbitrary temperature, in the stricter formulation of the generalized Thomas–Fermi–Dirac atom model given by Ashkin and Cowan. A.

539.153.4 : 535.33

ENERGY LEVELS OF ACTINIUM. See Abstr. 7727

539.155.2

8116. APPARATUS FOR STANDARD MEASUREMENT OF THE ISOTOPIC EXCHANGE OF DEUTERIUM BETWEEN HYDROGEN AND WATER VAPOUR AT ATMOSPHERIC PRESSURE AND 100° C. M.Silvestri and N.Adorni.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 266-74 (Jan., 1957).
In Italian.

Measurements of the deuterium concentration in hydrogen can be made in two ways: by thermal conductivity directly on the gas, or by a float method on the water obtained by combustion of hydrogen with oxygen. The fraction of conversion (β) is chosen as the measure of operational efficiency of the catalyst. Accuracy for β is of the order of ±5%. A.

539.156

8117. ON THE RADIATIVE CONTRIBUTIONS TO THE VAN DER WAALS FORCE. E.A.Power and S.Zienau.
Nuovo Cimento, Vol. 6, No. 1, 7-17 (July, 1957).

The effect of the electromagnetic interaction between two neutral atoms is important for large separations where the London potential proportional to R^{-6} is altered and becomes the Casimir–Polder potential varying as R^{-7}. It is shown that the interaction energy, for all separations, may be computed in a relatively simple manner by quantum electrodynamics with the aid of a reduced Hamiltonian involving transverse quanta alone. This Hamiltonian function is justified by an appeal to the dipole approximation in the Lagrangian. A.

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08 : 536.628.2

8118. CONSTRUCTION OF AN AUTOMATIC DEVICE FOR ADIABATIC MICROCALORIMETRY. APPLICATION TO THE MEASUREMENT OF RADIOACTIVE HALF-LIVES [RADON] AND TO THE COMPARISON OF RADIUM STANDARDS. M.Lecoin and J.Robert.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 150A-158A (Nov., 1956).
In French.

The half-life of radon was found to be 3.825 ± 0.004 days. The instrument was also used successfully to compare radium standards of widely differing Ra content. A.O.Stanesby

539.16.08 : 550.9

8119. RADIOCARBON DATING WITH LIQUID CO_2 AS DILUENT IN A SCINTILLATION SOLUTION. G.W.Barendsen.
Rev. sci. Instrum., Vol. 28, No. 6, 430-2 (June, 1957).

The use of the scintillation technique for radiocarbon dating has until now been retarded by the difficulties encountered in the chemical procedure. This paper shows it to be feasible to use the carbon dioxide obtained by combustion of the sample, without any further chemical conversion, as a diluent in a scintillation solution. Up to 80% by weight and possibly more liquid carbon dioxide can be dissolved in toluene +5 g/l. diphenyloxazole (PPO). However, the

presence of CO_2 in the scintillator interferes somewhat with the light emission in such a way that the decrease in pulse height, as compared with pure toluene +5 g/l. PPO, is 50% for 20% by weight dissolved CO_2. This limits the percentage of CO_2 that can be used effectively to about 30%. The counting rate due to modern carbon is 9.1 c/min, and the background is 15.5 c/min. Measurements indicate however that both these figures can be improved considerably, so as to make this technique at least comparable with the gas-counting technique. A.

539.163

8120. RADIOACTIVE UNIFORM EXTENDED SOURCES.
G.W.C.Tait and R.E.Townshend.
Rev. sci. Instrum., Vol. 28, No. 7, 542-3 (July, 1957).

A device is described for producing a uniform distribution of a solution of radioactive material over a large area source. Droplets of controlled size are expressed from a syringe at a constant rate and systematically and uniformly placed over an area up to 50 centimetres square. A.

539.163

8121. EVIDENCE OF A LIGHT ISOTOPE OF RUBIDIUM.
R.Chaminade, M.Cros, I.Gratot and M.Le Pape.
Nuclear Physics, Vol. 2, No. 5, 634-9 (Jan., 1957). In French.

It is shown that the reactions Cu + O, Cu + Ne, Ga + N lead to the formation of a new isotope of Rb, a β^+ emitter of period 24 ± 1 min emitting a complex γ-radiation of about 150 keV; its mass number is probably 70. A.

539.163 : 539.166.2

8122. NEW ISOMERS WITH SHORT HALF-LIVES IN THE MILLISECOND RANGE.
O.I.Leĭpunskiĭ, A.M.Morozov, Yu.V.Makarov and P.A.Yampol'skiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 393-4 (1957). In Russian.

Isomeric states with half-lives in the millisecond region, resulting from reactions of 20 MeV protons with a number of elements, were investigated. The energies of γ-radiation and the mean values of half-lives of the isomers are given. Z.Krasucki

539.163.1

8123. IRON 60. J.C.Roy and T.P.Kohman.
Canad. J. Phys., Vol. 35, No. 5, 649-55 (May, 1957).

The long-lived radionuclide Fe^{60} has been observed through extraction of its disintegration product, 10 min Co^{60m}, from the iron fraction isolated from a copper target bombarded with ~400 MeV protons. Direct observation was prevented by the Fe^{59} present. Yield considerations indicate the Fe^{60} half-life to be ~ 3×10^5 years, uncertain by a factor of 3. A.

539.163.1

8124. ON A REPORTED ISOMERIC STATE IN Mn^{54}.
K.G.McNeill, J.D.Prentice, L.Katz and W.Link.
Canad. J. Phys., Vol. 35, No. 6, 753-6 (June, 1957).

An attempt was made to detect the 2 minute isomeric state in Mn^{54} reported by Caldwell and Stoddart. Irradiation of pure Mn^{55} with various energy bremsstrahlung of 12 to 24 MeV failed to disclose any (γ,n) reactions leading to this state. Iron targets irradiated by 13.5 MeV neutrons failed to disclose any positron activity of 2 min half-life resulting from an (n,p) reaction to this state. In view of these experiments it is concluded that the existence of the reported isomeric state in Mn^{54} should not be accepted without reservation. A

539.163.1

8125. ELECTRIC MONOPOLE TRANSITION RATE IN Zr^{90}.
M.Deutsch.
Nuclear Physics, Vol. 3, No. 1, 83-93 (March, 1957).

The mean life of the 1.75 MeV excited state in Zr^{90} with J = 0, even parity, has been found to be 8.5 ± 3 mμsec by observing delayed coincidences between beta-rays from Y^{90} and annihilation radiation due to internal pair creation. This corresponds to $\rho^2 = 0.036$, close to the values for the other three known monopole transition probabilities. A.

539.163.2

8126. THE DECAY OF Au^{193} AND LEVEL SCHEME OF Pt^{193}.
G.T.Ewan.
Canad. J. Phys., Vol. 35, No. 5, 672-92 (May, 1957).

Au^{193} has been produced as the daughter of Hg^{193} formed by the reaction Au^{197} (p,5n) Hg^{193} in a synchrocyclotron. The internal conversion spectrum and unconverted γ-ray spectrum have been examined using β-ray spectrometers, NaI spectrometers, and coincidence techniques. Au^{193} decays by electron capture to Pt^{193} with a half-life of 17.5 ± 0.2 hr. An upper limit of 0.08% per disintegration has been placed on the probability of emission of positrons in this decay. Twenty-eight γ-rays, all below 500 keV, have been observed associated with the decay of Au^{193}. The first excited state of Pt^{193} has been shown to be at 12.7 keV and the lifetime of this state measured as $(2.2 \pm 0.8) \times 10^{-9}$ sec. A level scheme is proposed for Pt^{193}. A.

539.163.2

8127. OF DECAY Eu^{152} AND Eu^{152m}. O.Nathan and M.A.Waggoner.
Nuclear Physics, Vol. 2, No. 5, 548-74 (Jan., 1957).

Using magnetic and scintillation spectrometers and coincidence techniques the radiations from pile-irradiated natural europium have been studied. The energies of a number of beta- and gamma-rays and internal conversion lines were measured and isotopic assignments were made from the coincidence data. The internal conversion coefficients of a number of the transitions are determined from measurements of the relative intensities of gamma-rays and internal conversion lines. Decay schemes are proposed for the two isomers of Eu^{152} and plausible spin and parity assignments for some of the excited states of Sm^{152} and Gd^{152} are presented. The difference in level structure between these two nuclei is discussed in the light of the Bohr–Mottelson unified model and it is suggested that some of the high-lying excited states may possibly be interpreted as collective vibrations of the electric quadrupole and electric octupole type. A.

539.163.2

8128. INTERNAL BREMSSTRAHLUNG AND DECAY SCHEME OF Sb^{119}. J.L.Olsen, L.G.Mann and M.Lindner.
Phys. Rev., Vol. 106, No. 5, 985-90 (June 1, 1957).

The spectrum and yield of internal bremsstrahlung accompanying electron capture form S- and P-states in Sb^{119} were measured and compared with the theory of Glauber and Martin. Sb^{119} was obtained as the daughter from Te^{119} produced by the Sb(d,xn)Te^{119} and Sn(α,xn)Te^{119} and Sn(α,xn)Te^{119} reactions. The decay is by orbital electron capture to the 23.83 keV state in Sn^{119}. The following results were obtained: Sb^{119} half-life, 38.0 hr; Sb^{119}–Sn^{119} decay energy, 579 ± 20 keV; half-life of the 23.83 keV state and its total conversion coefficient, $(1.85 \pm 0.1) \times 10^{-8}$ sec and 6.3 ± 0.4, respectively. The intensity of internal bremsstrahlung for capture from S-states was $(1.06 \pm 0.15) \times 10^{-4}$ quanta/K-capture. This agrees with the theoretical prediction of 0.97×10^{-4}. The large contribution at low energies from P-state capture was measured down to 70 keV and agrees with the theory in its present state of completion. A.

539.163.2 : 539.172.4

DECAY OF N^{16} AND N^{17}. See Abstr. 7393

539.164.1

8129. THE ENERGY OF ALPHA PARTICLES FROM U^{234}, U^{238}, AND Th^{232}. B.G.Harvey, H.G.Jackson, T.A.Eastwood and G.C.Hanna.
Canad. J. Phys., Vol. 35, No. 3, 258-70 (March, 1957).

The α-particle energies of U^{234}, U^{238}, and Th^{232} have been measured with a grid ionization chamber. The electronic equipment was designed to provide low noise, high resolution, and good long term stability. Ra^{226}, Em^{222}, Po^{218}, Po^{214}, and Po^{210} were used as energy standards. An investigation was made of the corrections to the measurements due to variation in pulse rise-time, source thickness, and imperfect shielding of the collector by the grid. It was found that the experimentally observed resolution was satisfactorily accounted for by the combination of these factors and the noise and ionization straggling. Alpha-particle pulse heights were measured in terms of the output of a precision pulse generator. The corrected pulse heights were related to the energies of the standard sources by a two-parameter least squares calculation; the standard deviation was never greater than 5 keV. On extrapolating to zero ionization the line so obtained intercepted the energy axis at 83 keV. The α-particle energies deduced using this line were: U^{234} 4.768 ± 0.003, U^{238} 4.195 ± 0.005, Th^{232} 4.007 ± 0.005 MeV. A.

539.164.2

8130. THE THEORY OF ALPHA DISINTEGRATION.
K.C.Kar and S.P.Banerjee.
Indian J. theor. Phys., Vol. 3, No. 3, 89-105 (Sept., 1955).

It is shown that the upper limit of s introduced in the theory of Kar and Kundu (1953) should not be 2. It should be determined for a given Z from the experimental value of r_0' the lower limit of Coulomb scattering. With the value of s thus determined from Farwell and Wegner's (1954) data for Z = 82 and Z = 88, namely, s = 6.184 and s = 10.350 respectively, it is found that the theoretical values of disintegration constants of isotopes having no fine structure agree quite well with the experimental values and lie on a smooth log λ–E curve. The theoretical and experimental values of log λ

for minimum energy of emission in case of fine structure also lie on this curve. The agreement is decidely better than with Gamow's theory. It is further shown that the general downward trends of log λ–E curves in case of fine structure are also satisfactorily explained in the new theory. Gamow's theory fails to explain this characteristic of fine structure. A.

539.164.74 : 539.172.11

ELASTIC SCATTERING OF ALPHA PARTICLES.
See Abstr. 7368

539.165

8131. EVIDENCE FOR SMALL DEVIATIONS FROM THE ALLOWED SHAPE IN THE COMPARISON OF THE BETA SPECTRA OF Na^{24} AND P^{32}.
F.T.Porter, F.Wagner,Jr and M.S.Freedman.
Phys. Rev., Vol. 107, No. 1, 135-8 (July 1, 1957).

Two low-Z, similar-in-energy, presumably allowed beta transitions, Na^{24}(E_0 = 1394 keV, 4+ → 4+, log f_0t = 6.1) and P^{32}(E_0 = 1711 keV, 1+ → 0+, log f_0t = 7.9) have been compared by means of a double-lens spectrometer at 2% resolution. Vacuum-distilled sources on 200 $\mu g/cm^2$ Al had thicknesses of 50 to 75 $\mu g/cm^2$ for Na^{24} and $\ll 50\ \mu g/cm^2$ for P^{32}. Considerable attention has been given the question of detector efficiency and instrumental scattering. The results show that Na^{24} has very nearly the allowed shape; its experimental shape factor, $(N/[f(E_0 - E)^2])$, is within 0.5% that given by L_0 between 110 and 1300 keV. In contrast, the experimental shape factor for P^{32} decreases about 3% from 270 to 1630 keV with a slope ~4 times that of L_0. It is concluded that there is definite evidence for small deviations from the allowed shape in one of these transitions, and further, with a lower confidence level, that the slower P^{32} transition shows the deviation. While the deviation in P^{32} is not inconsistent with previous limits set on T-A interference, the large f_0t of P^{32} suggests that second-order effects may hold the explanation. A.

539.165

8132. BETA SPECTRUM OF Bi^{212} (ThC).
J.Burde and B.Rozner.
Phys. Rev., Vol. 107, No. 2, 531-6 (July 15, 1957).

The beta spectrum of Bi^{212} was measured by using a short magnetic-lens beta spectrometer. Pb^{212} in equilibrium with its decay products was used as a source. The spectrum of Bi^{212} was separated from the other component spectra by measuring the coincidences between the beta spectrum and the alpha-particles from Po^{212} (the nucleus formed after the beta decay of Bi^{212}) emitted with the half-life of 3×10^{-7} sec. One obtains a complex spectrum whose maximum energy is 2.27 MeV. The beta components were separated by Fermi plots. The end points for the component spectra and their relative intensities were found. Spins and parity assignments for the excited levels of Po^{212} were made. A.

539.165.08 : 539.166.08

8133. MONOENERGETIC ABSORPTION PEAKS OBTAINED WITH A SCINTILLATION SPECTROMETER. J.R.Haskins.
Rev. sci. Instrum., Vol. 28, No. 6, 425-6 (June, 1957).

The effect of finite channel width in distorting intensities of monoenergetic lines in a scintillation spectrometer is considered. It is found that peak area divided by channel width gives the rate of monoenergetic absorptions in the crystal. A correction to intensities proportional to the square root of the pulse height is not applicable. A.

539.165.2 : 539.166.835

8134. MEASUREMENT OF THE LONGITUDINAL POLARIZATION OF POSITRONS EMITTED BY SODIUM 22.
L.A.Page and M.Heinberg.
Phys. Rev., Vol. 106, No. 6, 1220-4 (June 15, 1957).

Measurement of the preponderance of 1 $^3S_{1,0}$ states of positronium over 1 $^1S_{0,0}$ states formed in a gas at moderately high field H (10 to 15 kilogauss), yields directly the preponderance of positron spins opposed to $\vec{H}$ over those parallel, just prior to capture; the magnitude and sign of the Paschen–Back effect may be inferred from the field value and the known triplet-singlet energy separation at zero field. By using suitable gases, the two-photon annihilation events from 1 $^3S_{1,0}$ are differentiated from those from 1 $^1S_{0,0}$ by requiring strict angular correlation at 180°; positronium atoms in the latter state, being only about 10^{-10} sec old at annihilation, have retained enough of the kinetic energy at formation to yield a broad angular correlation, while the former states, being on the average 30 times older at annihilation, yield a narrow component. The relative efficiency for counting the triplet/singlet states can in practice be made ~1.5, in the presence of all other two-quantum annihilation events. Positrons emitted into the hemisphere about +z, plus those scattered by the source material or source-backing into that hemisphere, are found to be polarized along +z by an amount 0.15. Taking, for those positrons ultimately slowed and counted, that $\langle v/c \rangle$ effective at emission is 0.75, it is implied that their longitudinal polarization at emission is at least $0.4\langle v/c \rangle$, this lower limit to apply if there be no backscattering, no depolarization during the slow process, and no de-alignment on the part of the positronium. The Na^{22} positrons are unmistakably right-handed. The sought-for connection between failure of parity conservation and polarization of betas from an unpolarized source is thus experimentally established. A.

539.165.2

8135. METHOD FOR TESTING TIME-REVERSAL INVARIANCE IN BETA DECAY. M.Morita and R.S.Morita.
Phys. Rev., Vol. 107, No. 1, 139-40 (July 1, 1957).

One of the possible tests of time-reversal invariance in weak interactions is the electron–neutrino angular correlation, for which no polarized nuclei and no measurements of the polarization of emitted electrons are required. If the electron–neutrino angular correlation function, e.g. $1 + (p/3W)f(g)\cos\theta$ (for $\Delta J = \pm 1$ transitions) has p and/or Z dependences in the measurements of f(g), invariance under time reversal T is not conserved. Conversely, if invariance under T holds, there are no p and Z dependences of f(g). In experiments, it is advisable to compare the f(g)'s for electron and positron decays. Furthermore, the experiment will be another possible test of charge-conjugation invariance if time-reversal invariance does not hold. A.

539.165.2

8136. TIME REVERSAL IN BETA-DECAY. J.S.Bell.
Proc. Phys. Soc. A, Vol. 70, Pt 7, 552-3 (July, 1957).

It is pointed out that, even if the weak interactions are invariant under time reversal, terms in the decay transition probability corresponding to higher than the first order in the coupling constant may not be invariant with respect to this operation.

J.W.G.Wignall

539.165.2 : 530.145

WEAK INTERACTIONS BETWEEN "OLD" PARTICLES AND BETA DECAY. See Abstr. 7588

539.166

8137. A LABORATORY Co^{60} SOURCE OF 60 CURIES.
I.G.Draganić, B.V.Radosavljević and N.J.Milašin.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 7, 151-6 (March, 1957).

A description is given for an economical laboratory source of 60 curies of radioactive cobalt. Dose rates achieved are 4×10^{18} eV $ml^{-1}hr^{-1}$ (1 ml irradiated volume) and 23.5×10^{18} eV $ml^{-1}hr^{-1}$ (10 ml irradiated volume). The dependence of absorbed dose on the height of irradiated layer in the sample is studied. Isodose regions are given for different conditions usually occuring during the work with the source, placed in a lead block and situated in the floor of the laboratory. A.

539.166

8138. DIRECTIONAL CORRELATION OF THE 0.845 AND 1.24 MeV γ-RAYS OF ^{56}Fe.
G.Bertolini, E.Lazzarini and M.M.Bettoni.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 356-62 (Feb., 1957).

The directional correlation of the 0.845 and 1.24 MeV γ–γ cascade of Fe^{56} in coincidence with the β^+ spectrum of 1.5 MeV maximum energy has been studied. The observed correlation function, after correction for the finite angular resolution of the detectors, is given by $W(\theta) = 1 + (0.1023 \pm 0.0027)P_2(\cos\theta) + (0.0015 \pm 0.0035)P_4(\cos\theta)$ according to a spin and multipolarity assignment 4(2)2(2)0. A.

539.166

8139. INTENSITIES OF X-RAYS AND γ RAYS IN Am^{241} ALPHA DECAY. L.B.Magnusson.
Phys. Rev., Vol. 107, No. 1, 161-70 (July 1, 1957).

Electromagnetic radiation intensities from levels of Np^{237} were remeasured with NaI scintillation detectors and an argon proportional chamber. By absolute and coincidence counting the photon intensities per alpha particle are 0.376, 0.025, 0.00073 and 0.359 for the L X-rays and the 26.4, 43.4 and 59.6 keV gamma rays, respectively. Gamma rays with 99 and 103 keV energy were found by α–γ coincidence. The 99 keV γ-ray is emitted from the 159 keV level with an intensity of 2.3×10^{-4}. The 103 keV γ-ray, of intensity 1.9×10^{-4} per alpha particle, is a de-excitation of the 103 keV level. The intensity of L X-rays from levels above 59.6 keV is 0.064. Coincidence intensities of 26 keV γ-rays with L X-rays from conversion of the 33.2 keV γ-ray and of L X-rays from these transitions are 0.01 and 0.031 per alpha particle, respectively. A.

539.166.08

8140. LEAD GLASS ČERENKOV RADIATION PHOTON SPECTROMETER. J.M.Brabant, B.J.Moyer and R.Wallace.
Rev. sci. Instrum., Vol. 28, No. 6, 421-4 (June, 1957).

A spectrometer for analysing photons of energies extending up to several BeV has been constructed and used successfully. This instrument essentially consists of a cylinder of glass, 12 in. dia. and 14 in. long containing 52% of PbO, viewed by four 5 in. dia. photomultipliers. High-energy photons incident along the spectrometer axis produce electron showers in the transparent high-Z glass. The total Cherenkov radiation emitted by these electrons and detected by the phototubes is nearly proportional to the energy of the incident photon, from 50 MeV to at least 1.4 BeV. The spectrometer has been calibrated over this range of photon energies by the pulses produced by electrons of the same energies. Above 200 MeV the measured energy resolution of the spectrometer is 30% and is approximately independent of energy. For elimination of incident charged particles during the analysis of γ-rays the spectrometer is operated in coincidence with a preceding photon-identifying counter system. A.

539.166.2 : 539.166.835

8141. INTERNAL COMPTON EFFECT IN PAIR CONVERSION. E.G.Melikyan.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 384-5 (1957). In Russian.

The differential cross-section is calculated for the process in which the nucleus decays, emitting a γ-ray together with a pair. G.E.Brown

539.166.2 : 539.18

8142. EXPERIMENTAL COMPARISON OF ENERGY SPECTRA OF THE γ-QUANTA FROM THE DISINTEGRATION OF π^0-MESONS PRODUCED BY 660 MeV PROTONS ON NUCLEI OF CARBON AND LEAD. Yu.D.Bayukov, A.N.Sinaev and A.A.Tyapkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 385-6 (1957). In Russian.

The following values were obtained:

E_γ (MeV)	$d\sigma_{Pb}/d\sigma_C$
30	6.4 ± 0.4
52	4.9 ± 0.15
90	4.15 ± 0.15
144	3.5 ± 0.1
222	3.3 ± 0.1
303	3.2 ± 0.1
348	3.1 ± 0.1
379	3.6 ± 0.2
472	4.1 ± 0.3

where E_γ is the energy of the gamma rays and $d\sigma_{Pb}/d\sigma_C$ the ratio of π-meson production cross-sections at 0° to the incident beam (see also A.A.Tyapkin et al. 9147/1955). S.Chomet

539.166.2 : 539.172.13

GAMMA RADIATION PRODUCED BY IRRADIATING B^{10} WITH PROTONS IN THE ENERGY RANGE 0.7 TO 3.0 MeV. See Abstr. 7374

539.166.75

8143. ABSORPTION COEFFICIENTS OF Co^{60} GAMMA RAYS. A.M.Ghose and N.K.Ganguly.
Trans Bose Res. Inst. Calcutta, Vol. 19, 141-53 (1953-55).

Absorption cross-section of Co^{60} gamma-rays for different absorbers have been measured using Geiger–Müller counters as detectors. An analysis has been made of the errors present in this type of experiment, caused by the scattered radiations entering the detector system. By eliminating these sources of errors, a condition was obtained in which the expected accuracy of the results was within 0.5 per cent. Theoretical values for photoelectric, pair-creation, and Compton cross-sections have been computed for cobalt gamma-rays. The measured values of cross-sections agree with the theoretical values within 1 per cent for copper and iodine, with 2 per cent for lead, aluminium and oxygen. Bromine shows a deviation of 2.4 per cent, which necessitates re-evaluation of the cross-section. In this connection the following factor influencing the results was considered. The absorption cross-sections measured in this experiment were the composite cross-sections in which the contribution of both the gamma-rays emitted by Co^{60} source were involved. The theoretically expected values were computed by taking the efficiency of the detector proportional to the gamma-ray energy. A.

539.166.835

8144. VARIATIONS IN THE AMOUNTS OF POSITRONIUM FORMED IN LIQUIDS AND AMORPHOUS SOLIDS.
R.E.Green and R.E.Bell.
Canad. J. Phys., Vol. 35, No. 4, 398-409 (April, 1957).

Measurements are reported of the intensity, I_2, of the long-lived (τ_2) component of positron annihilations in a number of liquids and amorphous solids. Large variations in I_2 have been found with different samples of similar substances. It is shown, for example, that I_2 for fused quartz of good quality is about 51% of all the positron decays, and that an earlier published value of 29% probably referred to a 96% silica glass rather than to pure fused quartz. The new value, taken with the results of angular correlation measurements, gives convincing evidence that the annihilation of triplet positronium in condensed materials proceeds mainly by the "pickoff" mechanism. It is shown that the addition of NO_3^- and NO_2^- ions to water in increasing concentration depresses I_2 from its normal value of (21 ± 5)% to a value at least as low as 2% without any marked change in τ_2. This behaviour is explained in terms of the formation of the positron compound $e^+NO_3^-$ in the water. This hypothesis explains the shape of the curve of I_2 as a function of NO_3^- ion concentration and also gives a cross-section for the capture of positrons in rough agreement with expectation. A.

539.166.835 : 539.18

8145. PAIR-CREATION CROSS SECTION OF SPIN ONE-HALF PARTICLES POSSESSING AN ANOMALOUS MAGNETIC MOMENT. G.H.Rawitscher.
Phys. Rev., Vol. 107, No. 1, 274-6 (July 1, 1957).

The electromagnetic pair-production cross-section of spin-½ particles possessing an anomalous magnetic moment λ (in units of $eh/2mc$) is calculated. The result is compared with the experimental measurement of the pair production of μ-mesons, and it is found that $-0.4 < \lambda < 0.2$. A.

NUCLEAR REACTIONS 539.17

539.172

8146. SUM RULE FOR OPTICAL NUCLEAR REACTIONS. H.Morinaga and D.C.Peaslee.
Nuclear Physics, Vol. 3, No. 1, 115-20 (March, 1957).

The direct or optical component of nuclear reactions is computed essentially by a first-order perturbation procedure. It should thus be subject to simple sum rules. One such rule is applied to elastic and inelastic α-particle scattering on Ne^{20}, where it is in qualitative accord with the observed smoothing out of fluctuations in the summed angular distributions. A.

539.172

8147. NUCLEAR REACTIONS. A.M.Lane.
Rev. mod. Phys., Vol. 29, No. 2, 191-9 (April, 1957).

International Congress review paper (see Abstr. 5814/1957). A survey of the theory of nuclear reactions with particular emphasis on the cloudy crystal ball model. The main topics discussed are: the variation with energy of the real and imaginary parts of the potential in the cloudy crystal ball picture and their physical significance; the relationship between this model and the "strength function" representation; the statistical theories of reactions (cascade and compound nucleus "evaporation") and surface reactions ("stripping" and "pick-up") at low energies. W.O.Lock

539.172 : 537.533.74

8148. ELASTIC AND INELASTIC SCATTERING OF HIGH ENERGY ELECTRONS BY SOME 2p-SHELL NUCLEI ON THE INTERMEDIATE COUPLING MODEL. M.K.Pal, S.Mukherjee and A.K.Saha.
Indian J. Phys., Vol. 31, No. 1, 56-9 (Jan., 1957).

A simplified form of nuclear Hamiltonian is used to calculate the elastic and inelastic scattering of high-energy electrons by Be^9. The inelastic cross-sections come out low by a factor independent of the angle of scattering. A qualitative fit to the scattering of C^{12} is achieved. J.M.Cassels

539.172

8149. THE SCATTERING OF FAST CHARGED PARTICLES. III. ON THE SINGLE SCATTERING OF HIGH ENERGY POSITRONS AND ELECTRONS AT SMALL ANGLES.
K.R.Allen, K.Phillips and F.Whittaker.
Proc. Phys. Soc. A, Vol. 70, Pt 7, 536-9 (July, 1957).

For Pt II, see Abstr. 6535 (1957). The Mott cross-section for

Coulomb scattering, taken to fourth order in $\alpha = Z/137$, was evaluated numerically for scattering angles, θ, $< 30^0$. Results for Xe^{54}, quoted in terms of the ratio to Rutherford scattering, fit well with previous data at $\theta = 30^0$ and 45^0. N.M.King

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172.1

8150. COMPARISON OF THE REACTIONS OF $Co^{59} + Ne^{20}$ AND $Cu^{63} + O^{16}$. M.Crut, H.Faraggi, J.Olkowsky and H.Atterling.
Nuclear Physics, Vol. 2, No. 5, 624-33 (Jan., 1957). In French.

Comparison of the reactions shows that they take place mainly through the formation of the same compound nucleus Rb^{79}. The production of Ga^{67}, however, is different in the two cases and must therefore be due in part to some other process. A.

539.172.1

8151. DIFFERENTIAL CROSS SECTIONS FOR THE $C^{13}(He^3,p)N^{15}$ REACTION.
E.G.Illsley, H.D.Holmgren, R.L.Johnston and E.A.Wolicki.
Phys. Rev., Vol. 107, No. 2, 538-9 (July 15, 1957).

The differential cross-sections, leaving N^{15} in the ground state, have been measured at 17 angles for bombarding energies of 2.0 and 4.5 MeV and at 6 angles in 0.2 MeV intervals from 1.8 to 3.8 MeV. The angular distributions are generally peaked in the forward and backward directions and change relatively slowly with bombarding energy. The angular distributions at 2.0 and 4.5 MeV have been fitted with Legendre polynomial expansions by using the method of least squares. The data indicate a weak resonance at a bombarding energy of about 3.6 MeV. A.

539.172.13

8152. TRIPLE FISSION OF URANIUM BY FAST PARTICLES.
N.A.Perfilov, V.P.Shamov and O.V.Lozhkin.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 1, 75-7 (1957). In Russian.

A three-prong event, found in a uranium-loaded emulsion exposed to 660 MeV protons, is interpreted as the triple fission of uranium into two fragments of $Z \sim 40$ and a third fragment of $Z \sim 10$. Possible mechanisms for this reaction are discussed. W.O.Lock

539.172.13

8153. THE ANGULAR DISTRIBUTION AND CROSS-SECTION OF THE REACTION $Li^7(p,\alpha)\alpha$ BELOW 600 keV. U.Timm.
Naturwissenschaften, Vol. 44, No. 9, 279 (1957). In German.

Three resonances were located accurately at 390, 440 and 480 keV, corresponding to resonance levels in the intermediate nucleus Be^8 at 17.58, 17.63 and 17.66 MeV, thus resolving the resonance found at 17.6 ± 0.3 MeV by Goward and Wilkins (1955). The angular distribution agrees, especially towards higher energies, with the results of Cartwright, Green and Willmott (1954).
D.H.Lord

539.172.13 : 537.591.8

8154. INELASTIC INTERACTIONS OF PROTONS WITH ENERGY GREATER THAN 7 BeV WITH CARBON AND HYDROGEN NUCLEI.
K.I.Alekseeva and N.L.Grigorov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 404-5 (1957). In Russian.

A counter telescope was used to measure the production of showers by cosmic-ray protons in graphite and paraffin, and values of the inelastic cross-sections in carbon (~300, 270 millibarns by two different methods) and hydrogen (~35 millibarns) are derived. J.W.G.Wignall

539.172.13

8155. A CONTRIBUTION TO THE INTERPRETATION OF THE (d,p) REACTION PRODUCED BY LOW ENERGY DEUTERONS.
M.K.Jurić.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 7, 1-16 (March, 1957).

An attempt has been made to explain the mechanism of the (d,p) reaction produced by deuterons of the energy lower than the Coulomb barrier. Experimental curves of the angular distribution of protons from the (d,p) reaction on Be^9, C^{12} and O^{16} have been compared with theoretical curves obtained by means of the Tobocman—Kalos method. From the agreement between experimental and theoretical curves, it could be concluded that stripping is dominant also at low deuteron energies. Besides the Butler and Coulomb effects, the angular distribution is greatly influenced by the effects of interaction between the particles of the reaction. A.

539.172.13

8156. REACTION $F^{19}(d,p)F^{20}$ AND THE SPIN OF F^{20}.
F.D.Seward, I.Slaus and H.W.Fulbright.
Phys. Rev., Vol. 107, No. 1, 159-60 (July 1, 1957).

New measurements of the angular distribution of the protons from the reaction $F^{19}(d,p)F^{20}$ made with deuterons in the range $3.5 \leq E_d \leq 4.1$ MeV show that the reaction proceeds mainly by compound-nucleus formation, and that stripping makes at most a small contribution. It follows that the interpretation of the results of an earlier experiment in terms of stripping is unjustified, hence that the spin of F^{20} is not necessarily 1. At all energies the angular distribution of protons leaving F^{20} in its first excited state shows a clear stripping-curve corresponding to $l_n = 2$ A.

539.172.13

8157. ANGULAR DISTRIBUTION OF PROTONS FROM THE $Ca^{42}(d,p)Ca^{43}$ REACTION.
C.K.Bockelman, C.M.Braams, C.P.Browne, W.W.Buechner, R.R.Sharp and A.Sperduto.
Phys. Rev., Vol. 107, No. 1, 176-81 (July 1, 1957).

The broad-range magnetic spectrograph was employed in conjunction with a 7 MeV deuteron beam from an electrostatic generato to obtain angular distributions and relative cross-sections for the twelve most intense proton groups corresponding to Ca^{43} levels up to 3.6 MeV excitation. The angular momenta of the captured neutrons were determined by application of deuteron stripping theory. A

539.172.1

8158. ANGULAR DISTRIBUTION OF PROTONS FROM THE $Ca^{44}(d,p)Ca^{45}$ REACTION. W.R.Cobb and D.B.Guthe.
Phys. Rev., Vol. 107, No. 1, 181-5 (July 1, 1957).

The broad-range magnetic spectrograph has been used to study proton groups produced from thin Ca^{44} targets bombarded by 7 MeV deuterons. The angular distributions and relative intensities of groups corresponding to levels in Ca^{45} were measured. Stripping theory was employed to determine the angular momenta of the captured neutrons. A

539.172.1

8159. DEPENDENCE OF POLARIZATION OF (D+D)-NEUTRONS ON THE DEUTERON ENERGY.
I.I.Levintov, A.V.Miller, É.Z.Tarumov and V.N.Shamshev.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 375-6 (1957). In Russian.

The polarization of (D—D)-neutrons was measured using the new method which is described in (Abstr. 6623/1957). It is shown, that for deuteron energies up to 1.8 MeV the polarization of (D—D)-neutrons increases smoothly with the deuteron energy.
Z.Krasuck

539.172.

8160. STUDY OF THE REACTIONS $Se^{82}(\gamma,n)Se^{81}$ AND $Se^{82}(\gamma,n)Se^{8}$
E.Silva and J.Goldemberg.
An. Acad. Brasil. Ciênc., Vol. 28, No. 3, 275-80 (Sept., 1956).
In Portuguese.

The cross-section for the first process has a maximum of about 100 millibarn at about 15 MeV, that for the second process has a slightly lower and flatter maximum at about 16 MeV. The ratio of the two cross-sections decreases from a value ~3 at 10 Me to below 1 at 20 MeV. Results are in broad agreement with theoretical predictions. L.Pincherl

539.172.

8161. PHOTONEUTRON EMISSION FROM Th^{232}, U^{233}, U^{238}, AND Pu^{239}. L.Katz, K.G.McNeill, M.LeBlanc and F.Brown.
Canad. J. Phys., Vol. 35, No. 4, 470-6 (April, 1957).

Measurements have been made of the numbers of neutrons emitted by the fissile materials Th^{232}, U^{233}, U^{238}, and Pu^{239} under irradiation by betatron X-rays of various energies up to 23 MeV. Yield curves and corresponding cross-section curves are given for these nuclides. At low X-ray energies it is found that the yield curves differ from those found with non-fissile heavy elements, corresponding to the fact that even at zero X-ray energy the fissile materials suffer (spontaneous) fission. A

539.172

8162. ENERGY AND ANGULAR DISTRIBUTIONS OF FAST PHOTOPROTONS FROM Ni AND Al.
E.B.Bazhanov, Yu.M.Volkov, A.P.Komar, L.A.Kul'chitskiĭ and V.P.Chizhov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 1, 65-7 (1957). In Russian.

A scintillator telescope was used to study the distributions of

photoprotons from Ni and Al irradiated with the bremsstrahlung photon spectrum of $E_{\gamma max} = 85 \mp 5$ MeV. The energy distributions of protons from the two elements can be represented in the form E_p^{-n}. The value of the exponent n for the part of the spectrum of protons with energies higher than 33 MeV is more than twice the value of n for protons of smaller energies. Angular distributions of protons from Ni for two energy intervals of protons show that the degree of asymmetry in the angular distribution increases with increasing energy of protons. Z.Krasucki

539.172.3

8163. FAST NEUTRON COMPONENT IN PHOTONUCLEAR REACTIONS.
F.Ferrero, L.Gonella, R.Malvano, C.Tribuno and A.O.Hanson.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 242-8 (Jan., 1957).

Preliminary results are given for many elements with special attention to Al, Cu, Ag, Ba, Au and Bi. A.

539.172.3

8164. DIFFRACTION PRODUCTION OF PROTON–ANTI-PROTON PAIRS BY HIGH-ENERGY PHOTONS.
A.G.Sitenko and L.N.Rozentsveĭg.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 383 (1957). In Russian.

The wave-functions are taken as plane waves plus waves diffracted from the nucleus. The cross-section is given for small angles and large energies. G.E.Brown

539.172.3 : 539.18

PHOTOPRODUCTION OF π^0-MESONS ON COMPLEX NUCLEI.
See Abstr. 7436

539.172.4

8165. THE THERMAL NEUTRON CROSS-SECTION OF BORON.
P.A.Egelstaff.
APPENDIX: THE PREPARATION OF A BORON SOLUTION FOR NEUTRAL TRANSMISSION MEASUREMENT. E.Bowell.
Atomic Energy Res. Establ. (Harwell) Mem. No. N/M62, 8 pp. (1957).

The capture cross-section of boron for 2200 m/sec neutrons is determined, from transmission measurements, to be 781 ± 10 barns. A.

539.172.4

8166. EFFECT OF NEUTRON INTERACTION ON CRITICALITY. II.
G.W.Stuart.
J. appl. Phys., Vol. 28, No. 6, 677-9 (June, 1957).

For Pt I, see Abstr. 1621 (1957). A method for calculating the criticality conditions for spatially disconnected fissile regions based on the multiplication constant k is presented. To illustrate the method, the case of two interacting infinite water-tamped fissile slabs containing solutions of pure U^{235} in water is considered. A.

539.172.4

8167. THE REACTION $O^{16}(n,\alpha)C^{13}$.
K.Kimura, I.Kumabe, K.Miyake, H.Ogata and K.Miyasita.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1211-20 (Dec., 1956).

Using an ionization chamber filled with oxygen, this reaction has been observed. The chamber was irradiated with moderated Li–D fast neutrons having a continuous energy spectrum, and the output pulses produced by the reaction were registered and the pulse-height distribution was determined. Eighteen resonances were obtained corresponding to the excited levels of O^{17} at (9.66), (9.45), (9.21), 9.07, 8.90, 8.75, 8.52, (8.41), 8.27, 8.06, 7.93, 7.75, (7.57), (7.39), (7.28), (7.16), (7.09) and 6.89 MeV. A.

539.172.4 : 553.495

8168. RESONANCE CAPTURE OF NEUTRONS IN PITCHBLENDE.
W.Burkhardt.
Naturwissenschaften, Vol. 43, No. 23, 534 (1956). In German.

The isotopic composition of pitchblende from Katanga and the Great Bear Lake demands the existence of a slow-neutron flux. Such neutrons have to come from the disintegration of components within the ore. A process for the effective slowing down of these neutrons without resonance capture is required. From the known composition of the ore it has been deduced that the oxygen component is unlikely to give rise to such neutrons. If the water in the ore is considered however, agreement is obtained with the known data. D.J.A.Prowse

539.172.4 : 539.152.1

8169. (n,p) REACTION FOR GOLD. R.A.Peck, Jr.
Phys. Rev., Vol. 106, No. 5, 965-71 (June 1, 1957).

The paper reports an experimental study of the process $Au^{197}(n,p)Pt^{197}$ induced by 14 MeV neutrons, detecting protons in the angular range 10^0 to 45^0 with emulsions. Resolution is not adequate for the identification of single excited states, but the energy spectrum does display definite structure and five groups are distinguished, chiefly on the basis of gross differences in their angular distributions. The energy widths of these groups are smaller than expected in view of the target thickness. Positions of angular distribution peaks are utilized for the assignment of angular momentum changes. The corresponding excitations in Pt^{197}, with "final angular momentum" parameters and total cross-sections, are: 0.2 MeV, 2, 8.6 millibarns; 1.6 MeV, 0 (or 4), 2.2 millibarns; 2.9 MeV, 5, 2.0 millibarns; 4.4 MeV, 6, 5.2 Millibarns; 6.0 MeV, 4 (or 0), 2.5 millibarns. The sum of these cross-sections (20.5 millibarns) is the experimental value for the reaction cross-section, since the ground-state transition was probably not observed (cross-section estimated not over 0.6 millibarns) and no significant yield of protons was observed corresponding to Pt excitation between the highest listed and the maximum (13 MeV) represented in the spectrum. All cross-sections are subject to about 40% uncertainty in neutron flux, but statistical uncertainties are of order 20% or less. Maximum differential cross-sections for the groups, and their locations in the angular distributions, are tabulated. A.

539.172.4

8170. INELASTIC NEUTRON SCATTERING FROM RHODIUM AND NIOBIUM.
M.A.Rothman, D.M.Van Patter, V.S.Dubey, W.C.Porter and C.E.Mandeville.
Phys. Rev., Vol. 107, No. 1, 155-8 (July 1, 1957).

Inelastic scattering of neutrons has been used to study excited states in Rh^{103} and Nb^{93}. Gamma-rays have been observed from the 300 and 365 keV levels in Rh. Gamma-rays of 736 and 957 keV energy have beeen obtained from Nb. As a result of threshold measurements, these gamma-rays are interpreted as representing transitions to the 29 keV metastable state from levels at 764 and 977 keV in Nb. A.

539.172.4

8171. ON THE INTERPRETATION OF HIGH ENERGY FISSION.
L.Marquez.
Proc. Phys. Soc. A, Vol. 70, Pt 7, 546-8 (July, 1957).

The author calculates a value of (6.15 ± 1.5) MeV for the average energy per neutron of the neutrons emitted in fission of uranium by 147 MeV protons and using this value points out that the experiment on neutron-fission fragment correlations by Harding and Farley (Abstr. 2645/1957) is consistent with the theory that most of the neutrons are emitted by the fission fragments. J.W.G.Wignall

539.172.4

8172. DOUNREAY EXPERIMENTAL REACTOR STATION.
C.R.Tottle.
Nature (London), Vol. 179, 1048-50 (May 25, 1957).

The main fields of research and development at Dounreay are centred on the experimental fast reactor, the materials testing reactor and the experimental critical facility. The development of the fast reactor project at Risley is outlined, hingeing on the reactor physics experiments at Harwell, metallurgical developments at Culcheth, and development of the use of sodium as a coolant at Windscale and Capenhurst. The projected experimental programme is based on the step by step increase of reactor power leading eventually to the development of plutonium fuel elements capable of withstanding high burn-ups at high heat rating. The materials testing reactor will allow the irradiation of both complete experimental fuel elements in large test loops and of numerous samples of fuels and other materials. The experimental criticality group is concerned in obtaining accurate data applicable to the calculation of critical sizes in the complicated conditions occurring in processing plants for fissile materials. R.D.Smith

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

8173. Λ^0–NUCLEON POTENTIAL AND THE BINDING OF HYPERFRAGMENTS. L.M.Brown and M.Peshkin.
Phys. Rev., Vol. 107, No. 1, 272-4 (July 1, 1957).

The volume integral Ω of the effective interaction potential between the Λ hyperon and the nucleon has been calculated from the observed binding energies of hyperfragments of mass number 3, 4, 5, 7, and 9. An assumption of short-range, central, spin-independent

forces leads to a single value of $\Omega = (240 \pm 20) \times 10^{-39}$ MeV cm^3, independent of experimental uncertainties in the size and shape of nuclei and in the observed binding energies, except for the case of $_\Lambda He^5$. The additional freedom gained by assuming central spin-dependent forces does not permit the fitting of $_\Lambda He^5$ and the other hypernucleus. It is concluded that the explanation of the anomalously low value of Ω for $_\Lambda He^5$ is to be found in the nuclear properties of its alpha-particle core. A.

539.18

8174. DEMONSTRATION OF THE EXISTENCE OF THE Σ^0 HYPERON AND A MEASUREMENT OF ITS MASS.
R.Plano, N.Samios, M.Schwartz and J.Steinberger.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 216-19 (Jan., 1957).

Three events, demonstrating the existence of the Σ^0 hyperon, have been found in a propane bubble-chamber. The Q-value for the decay $\Sigma^0 \rightarrow \Lambda^0 + \gamma + Q$ has been measured to be (73.0 ± 3.5) MeV. A.

539.18

8175. FURTHER RESULTS ON PARITY CONSERVATION IN $\pi-\mu-e$ DECAYS. C.Castagnoli, C.Franzinetti and A.Manfredini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 684-8 (March, 1957).

This research was suggested by Lee and Yang (Abstr. 5596/1957) to verify parity conservation in weak interactions. In fact, if parity conservation is violated in both processes ($\pi-\mu$ and $\mu-e$ decays) the angular distribution of the electron with respect to the line of motion of the μ-meson in the system in which the π is at rest, is expected to follow the law $f(\omega) = \text{const} \times (1 + \alpha \cos\omega)$. A total of 1028 events gave $\alpha = -0.222 \pm 0.067$. The probability of α being zero (isotropic distribution) is found to be $\sim 3 \times 10^{-3}$. All the decays have been observed in plates exposed to cosmic rays. A.

539.18

8176. STUDY OF K^- AND $\bar{K}^0$ MESON STARS IN EMULSION.
R.G.Glasser, N.Seeman and G.A.Snow.
Phys. Rev., Vol. 107, No. 1, 277-9 (July 1, 1957).

108 K^- stars were found by area-scanning. The secondaries were followed and the hyperons were analysed. The lifetime for $\Sigma^+ \rightarrow p + \pi^0$ is $(1.38^{+1.39}_{-0.63}) \times 10^{-10}$ sec and for $\Sigma^\pm \rightarrow n + \pi^\pm$ is $(0.31^{+0.32}_{-0.10}) \times 10^{-10}$ sec. The latter figure is apparently in disagreement with the bubble-chamber data on lifetimes of hyperons. Two events which were caused by $\bar{K}^0$ mesons are described. A.

539.18

8177. ON THE UNIVERSAL INTERACTIONS. II. K-MESON DECAYS INTO PIONS. S.Oneda.
Nuclear Physics, Vol. 3, No. 1, 97-114 (March, 1957).

The idea of the previous work (Abstr. 7974/1956) which aimed at explaining the complicated interactions between elementary particles in terms of universal interactions is further explored, concentrating on the weak interactions between baryon–meson systems. Present experimental situations are analysed qualitatively by the simple phase-space arguments which suggest that it is more sensible to compare the lifetimes of Λ^0, θ^0 and τ^+-decays than to compare those of θ^0 and θ^+-decay. Taking $\Lambda^0 \rightarrow N + \pi$ interaction as the main source of the weak baryon–meson interactions, the required property of this interaction in isobaric spin space is investigated. As an orientation regarding the order of magnitude, the evaluations of the transition probabilities of θ-decays and τ-decays are made. The interactions which are responsible for the occurrence of the $\theta^+ \rightarrow \pi^+ + \pi^0$ are investigated. Connections with the compound particle models are briefly discussed. A.

539.18

8178. THREE-PION DECAY MODES OF NEUTRAL K MESONS.
A.Pais and S.B.Treiman.
Phys. Rev., Vol. 106, No. 5, 1106-7 (June 1, 1957).

It is pointed out that, if the τ and θ mesons are identical and spinless, and time reversal invariance holds, long-lived neutral K-particles would have a much larger branching ratio for three-pion decay than the short-lived component, in contrast to the result obtained if τ and θ mesons are different particles. The validity of the "$\Delta I = \frac{1}{2}$" rule, and experimental tests of this rule, are also discussed. J.W.G.Wignall

539.18

8179. THE VARIATION OF THE MEAN LIFE OF MUONS WITH THE ATOMIC NUMBER OF ABSORBER. N.N.Biswas and M.S.Sinha.
Trans Bose Res. Inst. Calcutta, Vol. 19, 49-59 (1953-55).

The delayed coincidence technique has been used to observe the decay of a composite beam of positive and negative μ-mesons at sea-level in Al, C, Pb and S absorbers. In cases of Al and S the points on a semi-logarithmic scale for the time intervals 0.6 to 4.0 μsec fit two straight lines, one yielding the lifetime of the composite beam and the other that of the positives alone. The composite mean lives are found to be 1.58 ± 0.07, 2.15 ± 0.09, 1.48 ± 0.08 μsec in Al, C, S respectively. The mean lives of positives in Al, Pb, and S are 2.35 ± 0.11, 2.23 ± 0.09 and 2.15 ± 0.14 μsec respectively. It has been concluded that the composite mean lives are dependent on Z, and decrease with increase of Z. The mean life of the negatives in C is determined to be 1.93 ± 0.24 μsec. From the data obtained, the ratio of positive to negative μ-mesons has been found to be 0.95 ± 0.16. This does not agree with the view of 20% excess of positive mesons and it is argued that the simple theory of meson production by the collision of a primary beam of protons with the air nuclei is not sufficient to account for the observed ratio. A.

539.18

8180. MEAN LIFE OF μ MESONS IN ELEMENTS AND COMPOUNDS. N.N.Biswas.
Trans Bose Res. Inst. Calcutta, Vol. 19, 79-87 (1953-55).

The composite mean life of μ-mesons stopped in elements (C, Mg) and compounds (NaOH) of low atomic numbers has been determined using a four-channel delay discriminator circuit. Assuming that the μ^+/μ^- ratio is nearly unity, the mean life of the negative μ-mesons was found to be equal to 2.04 ± 0.14 (carbon), 1.52 ± 0.14 (NaOH) μsec. A.

539.18

8181. THE MASSES OF LIGHT MESONS, K-MESONS AND HYPERONS IN 1956. K.M.Crowe.
Nuovo Cimento (Ser. 10), Vol. 5, No. 3, 541-61 (March, 1957).

A number of independent accurate measurements of the masses of light mesons are critically reviewed. Assuming the positive- and negative-charged mesons to have equal masses, best values for the pion and muon masses can be calculated. It is found that the negative π^- and μ-mesic X-ray energies measured by K absorption edges can be combined with the mass difference between the positive pion and muon to give a result with a standard deviation approximately one third of the assigned errors of the best previous measurement. All the results are in satisfactory agreement and can be combined in the usual way. The mass results are as follows: $M_\mu = (206.86 \pm 0.11)\, m_e$; $M_\pi = (273.27 \pm 0.11)\, m_e$. Experimental data on the mean lives, spins, parities, and decay modes are also reviewed and the results are given. The measurements of the masses of the various K-mesons are obtained in several ways: $M_{K\pi^2} = (966.0 \pm 1.5)\, m_e$; $M_{K\mu^2} = (965.3 \pm 1.9)\, m_e$; $M_\tau = (966.8 \pm \pm 0.4)\, m_e$. There is at present no evidence for a difference in the masses to a precision of 1-2 m_e. Results on the $K^+_{\pi 2}$ and τ^+ masses and lifetimes and the analysis of τ^+ decay are discussed. At present the experimental equality of these particles seems to be contradictory to assigning a spin of less than 2. The cosmic-ray data on the θ^0 lifetime are reviewed and recent results on artificially produced θ^0's are discussed. The hyperon mass data are reviewed. $M_{\Lambda^0} = (2\,181.74 \pm 0.35)\, m_e$; $M_{\Sigma^0} = (2327.4 \pm 1.0)\, m_e$. The latest data on a $\Sigma^+ - \Sigma^-$ mass difference and their mean lives are presented. A.

539.18

8182. MAGNETIC RESONANCE DETERMINATION OF THE MAGNETIC MOMENT OF THE μ MESON.
T.Coffin, R.L.Garwin, L.M.Lederman, S.Penman and A.M.Sachs.
Phys. Rev., Vol. 106, No. 5, 1108-10 (June 1, 1957).

The asymmetry in the angular distribution of positrons from polarized μ-mesons has been used as an indicator of spin flip in a magnetic resonance experiment. The gyromagnetic ratio obtained is 2.0064 ± 0.0048. J.W.G.Wignall

539.18

8183. ON THE SCATTERING OF K^+-MESONS BY NUCLEONS IN PERTURBATION THEORY. C.Ceolin and L.Taffara.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 435-47 (Feb., 1957).

Using the method of Feynman and considering both the Λ and Σ-particles as intermediate states, the differential and total cross-sections for the scattering of scalar and pseudoscalar K^+-mesons by nucleons have been calculated in the second order approximation of perturbation theory. As a result, the various values are given which may be assumed by the ratios:

$$R = \frac{\text{process with charge exchange}}{\text{process without charge exchange}} \quad \text{and} \quad R' = \frac{\sigma(K+N)}{\sigma(K+P)},$$

as a function of the ratio $s = g^2_\Lambda / g^2_\Sigma$ of the interaction constants for the reactions $N \rightarrow K + \Lambda$ and $N \rightarrow K + \Sigma$. These results are then discussed in relation to the few experimental data so far available. A.

539.18

8184. SCATTERING OF K^+ MESONS BY PROTONS.
D.I.Meyer, M.L.Perl and D.A.Glaser.
Phys. Rev., Vol. 107, No. 1, 279-82 (July 1, 1957).

The scattering of 20 to 90 MeV K^+ mesons by protons has been investigated by using a propane bubble-chamber. On the basis of 32 events, a total cross-section of 9.4 ± 1.7 mb is obtained. The experimental angular distribution is not isotropic. A.

539.18

8185. CAPTURE OF NEGATIVE K PARTICLES BY BOUND AND FREE PROTONS IN EMULSION.
F.C.Gilbert, C.E.Violet and R.S.White.
Phys. Rev., Vol. 107, No. 1, 228-38 (July 1, 1957).

The data presented include only those captures in which a charged π meson and one additional charged particle are emitted. A model is presented for K^--particle capture on bound protons in which the external energies of the emitted Σ hyperons and π mesons are modified from the values for captures on free protons by the internal proton momenta and the Coulomb and nuclear potentials. The model is used to explain the observed Σ^+- and Σ^--hyperon and π^-- and π^+-meson energy distributions. A Coulomb potential of 10 ± 3 MeV is estimated from the relative positions of the high-energy ends of the Σ^+- and Σ^--hyperon energy distributions. This value suggests that most of these captures were on the heavy elements of the emulsion. This potential reduces the ratio of Σ^- to Σ^+ hyperons, which escape the nucleus, from the value of 2 measured on free protons to the value 0.83 ± 0.25 for protons bound in emulsion nuclei. The sum of the binding energies of the last proton in the capture nucleus and the excitation energy of the residual nucleus has a distribution which is peaked at about 20 MeV. Conservation of energy and charge are applied to the identification of the Σ hyperons that end without making a visible star. The prong distribution for stars made by Σ^--hyperon captures in emulsion nuclei can be interpreted as a composite of two distributions: one, a line spectrum of zero-prong events, when the Λ^0 or Σ^0 hyperon and neutron escape; the other, a spectrum of many-prong events, when the Λ^0 or Σ^0 hyperon or neutron (or both) are absorbed. The number of Σ^- hyperons that were captured to give stars of zero or one prong is 0.65 ± 0.10. Seven Σ^+ hyperons that decayed into protons at rest are used to find a Σ^+-hyperon mass of $2329.5 \pm 1.0\ m_e$. Two examples of K^- captures on free protons in the emulsion give Σ^- hyperon masses of $2347.4 \pm 3.5\ m_e$ and $2341.8 \pm 1.5\ m_e$. A.

539.18

8186. OPTICAL MODEL FOR PRODUCTION OF Σ PARTICLES IN NUCLEI BY NEGATIVE K MESONS. R.H.Capps.
Phys. Rev., Vol. 107, No. 1, 239-48 (July 1, 1957).

The experimental data of the preceding abstract are interpreted by means of an optical model. It is assumed that the primary absorption interaction involves directly only a single nucleon, and that the impulse approximation is valid in this interaction. The observed spectra of Σ^+ and Σ^- particles emitted in two-prong stars indicate that the charge-independent part of the Σ-particle nuclear potential in the model must be attractive. From a comparison of the emulsion data with the results of stopping K^- particles in a hydrogen bubble chamber, limits are placed on the possible size of the cross-section in nuclei for the absorption of charged Σ particles by means of conversion to neutral Σ or Λ particles. A.

539.18

8187. THE VELOCITY DEPENDENCE OF ČERENKOV RADIATION FROM μ-MESONS. C.H.Millar and E.P.Hincks.
Canad. J. Phys., Vol. 35, No. 4, 363-72 (April, 1957).

The intensity--velocity relationship of the Cherenkov light emitted by μ-mesons passing through Plexiglas has been studied for the velocity range 0.83c to 0.99970c (84 MeV to 4.2 BeV). No departure of the observed from the theoretical intensity was found in the high-velocity region, in disagreement with the results of Bassi, Bianchi and Manduchi (1952). In the low-velocity region slightly less radiation was observed than expected, but this is attributed to an optical effect in the apparatus rather than to a departure from theory of the Cherenkov light emission. A.

539.18

8188. K^+-MESON INTERACTION WITH NUCLEONS AND NUCLEI.
G.Cocconi, G.Puppi, G.Quareni and A.Stanghellini.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 172-82 (Jan., 1957).

The results obtained in several laboratories on the nuclear interaction of the K^+-mesons of energy between 40 and 150 MeV have been analysed. It is assumed that all K^+-mesons have identical interaction properties and that Gell-Mann's scheme is correct. The main results are the following: (1) The total cross-section for the process $K^+ + p$ (isotopic spin state $T = 1$) is $\sigma_p = 14 \pm 3$ mb. The corresponding differential cross-section may be described essentially with S-wave and Coulombian constructive interference. (2) The isotopic spin state $T = 0$ is not negligible compared to $T = 1$. P-wave should be important in the $T = 0$ state. (3) To explain the K^+-meson interaction with nuclei, a nuclear repulsive potential $V \cong 10$ MeV should be added to the Coulombian potential. With these assumptions one can describe: (a) The elastic scattering in terms of the optical model. (b) The inelastic scattering, by considering the interaction due to single collisions of the K^+-mesons with the nucleons (which are considered as independent particles of a Fermi-gas). (4) The K^+-nucleon interaction in the $T = 1$ state may be described by a central potential equivalent to a hard-core of radius $a = 0.8\,(\hbar/m_K c)$. A.

539.18

8189. K^+ NUCLEI INTERACTIONS ACCORDING TO THE OPTICAL MODEL. G.Costa and G.Patergnani.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 448-60 (Feb., 1957).

The nuclear potential V_n has been determined by two different procedures: the first consists in the calculation of the elastic K^+–nucleus cross-sections as functions of V_n; the second connects V_n with the total inelastic K^+–nucleus cross-section through the elementary K^+–nucleon interaction, described by means of a Yukawa potential. The results obtained in the two cases are very similar. A.

539.18

8190. PION–NUCLEON INTERACTIONS.
S.J.Lindenbaum and R.M.Sternheimer.
Phys. Rev., Vol. 106, No. 5, 1107-8 (June 1, 1957).

The pion–nucleon total cross-section for isotopic spin $T = \frac{1}{2}$ is interpreted in terms of excitation of an isobar with $J = 3/2$, $T = 3/2$. The momentum spectra of pions emitted in 1.0 and 1.37 BeV pion–proton collisions are also calculated using this model, and are compared with experiment and with the predictions of the statistical theory. J.W.G.Wignall

539.18

8191. Λ^0–NUCLEON INTERACTION. E.M.Henley.
Phys. Rev., Vol. 106, No. 5, 1083-9 (June 1, 1957).

A study of the Λ^0–p or Λ^0–n force is of particular interest because the Λ^0–nucleon two-body force need not be related to the potential effective in binding hyperfragments. Thus, an exchange of a single pion between the Λ^0 and the nucleon is forbidden only in the two-body interaction. It is pointed out that the final-state interaction in the production of a Λ^0 and nucleon is the only effective means of studying this force that seems feasible at present. The effect of the Λ^0–nucleon interaction on the spectrum of K mesons produced in nucleon–nucleon and pion–deuteron collisions is investigated. It is pointed out that these experiments can also be used to determine whether the ${}_{\Lambda}H^2$ is bound. A.

539.18

8192. VERTEX CORRECTIONS TO THE PION K-MESON INTERACTION. S.F.Tuan.
Phys. Rev., Vol. 107, No. 1, 300-1 (July 1, 1957).

A vertex correction to Schwinger's fundamental pion–K-meson interaction is calculated to second order by the covariant S-matrix formalism. Certain prescriptions are made with regard to coupling constant renormalization such that the analogy with similar procedures in quantum electrodynamics become evident. A.

539.18

8193. ON THE THEORY OF MULTIPLE MESON PRODUCTION. Y.Takahashi.
Canad. J. Phys., Vol. 35, No. 4, 498-500 (April, 1957).

Starting from the author's expression for the n-meson production probability (Abstr. 8585/1956) the formalism is developed so that the effects of possible meson–meson interactions can be included. This results in a modified "spectrum volume" Ω, which would bring the ratio of two-meson to one-meson events into better agreement with experiment. J.W.G.Wignall

539.18

8194. MULTIPLE MESON PRODUCTION IN THE COSMIC RADIATION. E.Lohrmann.
Nuovo Cimento (Ser. 10), Vol. 5, No. 5, 1074-82 (May, 1957).

Six jets were selected from about 250 found in cosmic-ray plates with the aim to get events representing nucleon–nucleon collisions as closely as possible. Scattering measurements on the shower particles showed that the mean total energy of the mesons in the centre of mass system was 0.35 GeV for about 100 GeV

primary energy and 0.4 to 1 GeV for primary energies of 1000 GeV and more. A large fraction of the particles has small energies in the c.m.-system, thus favouring the Heisenberg theory of multiple meson production. No relation between the anisotropy of the angular distribution in the c.m.-system and the inelasticity was found. The inelasticity seems to vary within wide limits. An analysis of the angular distribution of six further jets presumably produced by mesons was carried out. The mean energy of these jets was 200 GeV. The angular distribution in the c.m.-system is isotropic within the limits of error. A.

539.18

8195. CHARGED Σ HYPERONS FROM 1001 K-MESON STARS.
W.F.Fry, J.Schneps, G.A.Snow, M.S.Swami and D.C.Wold.
Phys. Rev., Vol. 107, No. 1, 257-69 (July 1, 1957).

1001 K^--meson stars were found by area-scanning in four successive stacks of emulsion pellicles exposed to momentum-analysed negative channels at the Berkeley Bevatron. Systematic following of the prongs showed that there emerged from these stars 319 charged π mesons, 46 hyperfragments, and 158 identified charged hyperons. There were 26 $\Sigma^+ \rightarrow p + \pi^0$ decays at rest; 20 $\Sigma^+ \rightarrow \pi^+ + n$ decays at rest; 14 $\Sigma^+ \rightarrow p + \pi^0$ decays in flight; 26 $\Sigma^\pm \rightarrow \pi^\pm + n$ decays in flight; 50 Σ^- stars at rest, and 22 Σ^- zero-prong stars with Auger electrons. The branching ratio of the Σ^+ hyperon is found to be $R = (\Sigma^+ \rightarrow p)/(\Sigma^+ \rightarrow \pi^+) = 1.18 \pm 0.32$. The best single value for the Σ^+ lifetime, as determined from all $\Sigma^+ \rightarrow p$ decays, is $(0.96_{-0.21}^{+0.37}) \times 10^{-10}$ sec. For the Σ^- hyperons, a lifetime of $(2.5 \pm 0.8) \times 10^{-10}$ sec is deduced. However, the lifetime obtained from the mixture of $\Sigma^\pm \rightarrow \pi^\pm + n$ decays in flight alone is $(0.32_{-0.07}^{+0.11}) \times 10^{-10}$ sec. The angular distribution of $\theta_{\Sigma\pi}$, the angle between the decay π meson in the Σ rest system and the initial direction of motion of the Σ, was determined from 85 Σ decay events. Of these, 50 events have $|\cos\theta_{\Sigma\pi}| > 0.5$, and 53 events have $\theta_{\Sigma\pi} > 90^\circ$. Hence this sample of data suggests, but does not prove, that the spin of the Σ is greater than ½ and that there is parity-doubling for each Σ. Other topics are presented, including the energy distribution of the Σ hyperons, an analysis of stars produced by Σ^- hyperons, and the apparent nonvalidity of the isotopic-spin selection rule $\Delta T = \pm\frac{1}{2}$. A.

539.18

8196. THE THRESHOLD OF "PRODUCTION" AND "GENERATION" OF NEGATIVE K-MESONS.
M.Danysh and B.Pontekorvo (Pontecorvo).
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 398-9 (1957). In Russian.

Pais and Piccioni (Abstr. 1614/1956), have suggested an experiment to show whether the θ^0-particle is a "particle mixture". A variant of the Pais–Piccioni experiment is suggested.

S.Chomet

539.18

8197. PION PRODUCTION IN PION–NUCLEON COLLISIONS.
L.S.Rodberg.
Phys. Rev., Vol. 106, No. 5, 1090-9 (June 1, 1957).

The production of a single pion in pion–nucleon collisions has been studied by using the Chew–Low formalism with p-wave coupling. The equation for the T-matrix is solved by using the one-meson approximation. The solution is used to compute the cross-sections for pion production and the two-meson corrections to the scattering equation of Chew and Low (Abstr. 2680/1956). The production cross-sections show a peak due to overlapping final-state resonances, but have a magnitude of less than 2 mb, compared to the observed inelastic cross-sections of about 20 mb (near 1 BeV). The two-meson corrections to scattering are found to be quite small. A.

539.18

8198. CHARACTERISTICS OF π^0 PRODUCTION FROM PROTON–PROTON COLLISIONS NEAR THRESHOLD.
B.J.Moyer and R.K.Squire.
Phys. Rev., Vol. 107, No. 1, 283-90 (July 1, 1957).

The angular distribution and excitation function for neutral mesons produced by proton–proton collisions near threshold have been measured. It is found that P-state production of the mesons dominates at all energies except those quite close to threshold, where some S-state production can be detected. The total cross-section, at an energy where the maximum attainable centre-of-mass meson momentum is $\eta_0 M_\pi c$, can be stated as $\sigma(\text{mb}) = 0.02\eta_0^2$ (S state) + $+ 0.57\eta_0^8$ (P state). A.

539.185 : 517.514.3

8199. SPHERICAL-HARMONICS METHOD FOR NEUTRON-TRANSPORT PROBLEMS IN CYLINDRICAL GEOMETRY.
B.Davison.
Canad. J. Phys., Vol. 35, No. 5, 576-93 (May, 1957).

Deals with the application of the spherical-harmonics method to systems with complete cylindrical symmetry, that is, to systems invariant under rotation around and translation parallel to an axis. Closed-form expressions are given in an arbitrary order of approximation both for the spherical-harmonics moments in terms of the constants of integration and, conversely, for the constants of integration in terms of the spherical-harmonics moments. This removes the need for numerical inversion of matrices and simplifies the treatment of multilayer problems. See also Abstr. 2912 (1957).

A.

539.185

8200. NEUTRON SPECTRUM OF AN ACTINIUM–BERYLLIUM SOURCE. W.R.Dixon, A.Bielesch and K.W.Geiger.
Canad. J. Phys., Vol. 35, No. 6, 699-702 (June, 1957).

The neutron spectrum of an Ac^{227}–α–Be source has been determined from proton recoil tracks in nuclear emulsions, and found to be in general agreement with the spectra of Po–α–Be and Ra–α–Be sources. Direct observation is limited to neutron energies above about 0.5 MeV. The question of neutrons below this energy is also considered. A.

539.185

8201. ELASTIC NEUTRON–NEUTRON SCATTERING AT 300 MeV. V.P.Dzhelepov, B.M.Golovin and V.I.Satarov.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 943-6 (1954). In Russian.

The differential cross-section for neutron–neutron elastic scattering was determined by comparing the results obtained, under the same conditions, by n–p and n–d scattering. The calculations involved in this method and the means of allowing for the interference terms are thoroughly discussed. The computations connected with the practical counter arrangement are also examined in detail. Accurate values of the differential cross-sections in the centre-of-mass system are given. G.Martelli

539.185

8202. POLARIZED NEUTRON BEAMS.
G.H.Stafford, S.Tornabene and C.Whitehead.
Phys. Rev., Vol. 106, No. 4, 831-2 (May 15, 1957).

Neutrons produced by the irradiation of Be, C, Cu and W with 165 MeV protons were found to have a large positive polarization, $+0.35 \pm 0.05$ for Be and $+0.35 \pm 0.06$ for C at a lab. angle of 55°. A quasi-free (p,n) reaction is expected to give a negative value at this angle and it is suggested, therefore, that the proton beam may be polarized by the interaction with the nuclear surface before any appreciable neutron production takes place. E.J.Burge

539.185

8203. MODERATION OF FAST NEUTRONS IN MEDIA OF HIGH ATOMIC NUMBER. H.W.Schmidt.
Z. Phys., Vol. 148, No. 1, 128-34 (1957). In German.

The space- and energy-distributions are calculated, assuming that the energy lost is due solely to inelastic scattering. Examples are given for an exponential energy distribution of the primary neutrons, and for a monoenergic source. The one-dimensional transport equation is used in the calculations. A.O.Stanesby

539.185 : 536.48

THEORY OF INELASTIC SCATTERING OF COLD NEUTRONS FROM LIQUID HELIUM. See Abstr. 7827

539.185 : 537.311.32

ELECTRICAL RESISTIVITY OF GRAPHITE IRRADIATED WITH NEUTRONS. See Abstr. 7859

539.185.06

8204. HIGH RESOLUTION NEUTRON VELOCITY SPECTROMETER WITH BETATRON SOURCE.
M.L.Yeater, E.R.Gaerttner and G.C.Baldwin.
Rev. sci. Instrum., Vol. 28, No. 7, 514-24 (July, 1957).

A neutron velocity spectrometer with a 100 MeV betatron as a source of neutron pulses has been in use since 1953, for cross-section measurements up to about 50 000 eV. An internal, thick uranium target is bombarded by 80 MeV electrons when the betatron orbit is rapidly contracted, giving approximately 0.1 microsecond bursts of neutrons at a 60 pulse per sec repetition rate with a peak intensity of about 7×10^{15} neutrons per second. Measurements of total, capture, and fission cross-sections are made with high-resolution detecting equipment located at points up to 20 m from the target. The timing, registering, and data-processing techniques are designed to achieve maximum benefit from the short burst duration.

A.

STRUCTURE OF SOLIDS 539.2

539.21 : 541.15

8205. LOW-TEMPERATURE REACTOR IRRADIATION EFFECTS IN METALS. T.H.Blewitt, R.R.Coltman, C.E.Klabunde and T.S.Noggle.
J. appl. Phys., Vol. 28, No. 6, 639-44 (June, 1957).

The effects of structural and chemical defects on the low-temperature (30-50° K) annealing peak in low-temperature reactor-irradiated aluminum and copper were studied. From the fact that the density of reactor-induced defects did not affect the annealing kinetics, it was possible to conclude that the low-temperature annealing process was of the first order without a unique activation energy. The fact that both oversized and undersized atoms could suppress this annealing peak led to the conclusion that the radiation-induced defects were more complicated than simple point defects. The suggestion is made that a defect similar to a crowdion must be created by low-temperature neutron irradiation. This data also supports to some degree the viewpoint that a radiation-induced defect, possibly a crowdion, has sufficient knock-on energy to migrate several hundred atomic distances. The experiments also contain evidence which rule out all forms of vacancy-interstitial annihilation. A.

539.21 : 539.132

8206. NUCLEAR MAGNETIC RESONANCE IN IRRADIATED POLYETHYLENE. S.Fujiwara, A.Amamiya and K.Shinohara.
J. chem. Phys., Vol. 26, No. 5, 1343 (May, 1957).

Graphs are presented showing the second moment of the proton resonance and a derived degree of crystallinity over the range −10° C to 80° C for polyethylene before and after irradiation with a beam of deuterons. D.H.Whiffen

539.21

8207. SOME PROPERTIES OF NEPTUNIUM METAL.
V.W.Eldred and G.C.Curtis.
Nature (London), Vol. 179, 910 (May 4, 1957).

Data for a piece of metal prepared by a bomb reduction process are reported. The major impurities were Ca (0.34 wt/%); U (0.22); Ni (0.06); Mg, Cr, Pu (each 0.03). The density was 20.2 g/cm^3 at 20° C and mean specific heat (19-99° C), 0.0319 cal.g^{-1}.deg C^{-1}. Metallographic examination revealed inclusions of about 3% by volume and at least two types were recognized. Other data were: Mayer index 2.19; ultimate ball no. 458; Vickers hardness figure 355; and the results suggest an ultimate tensile strength of 80-90 tons/in^2 for Np. S.Weintroub

539.21

8208. DENSITY CHANGE OF SODIUM CHLORIDE PRODUCED BY PROTON IRRADIATION AND ITS THERMAL ANNEALING.
K.Kobayashi.
Phys. Rev., Vol. 107, No. 1, 41-3 (July 1, 1957).

The density change of sodium chloride crystals upon irradiation with 350 MeV protons with a total flux of 1 x 10^{16} protons/cm^2 has been measured and found to be −8.3 x 10^{-4} g/cm^3. The number of negative-ion vacancies calculated from this density change is of the same order as the number of F-centres estimated from the stored-energy measurements. The recovery of the density change with thermal annealing has also been studied. A relation between the behaviour of the density change and of colour centres is discussed. A.

539.21 : 539.185

8209. EXPANSION OF LiF UNDER NEUTRON IRRADIATION.
D.Binder and W.J.Sturm.
Phys. Rev., Vol. 107, No. 1, 106-7 (July 1, 1957).

The strain gauge method is applied to the relative linear expansion of LiF under neutron irradiation. The results is (9.9 ± 0.3) x 10^{-5} per 10^{18} thermal neutrons. An estimate of the number of displacements is in adequate agreement with theory. A.

539.21 : 535.376

THE DAMAGE TO PLASTIC SCINTILLATORS BY IONIZING RADIATIONS. See Abstr. 7782

539.211

8210. A METHOD OF MAKING DEFECTS ON RUBBER SURFACES VISIBLE. H.Lagoni and D.Merten.
Naturwissenschaften, Vol. 44, No. 6, 177 (1957). In German.

It is often difficult to distinguish irregularities of surface structure from surface damage in a microscope. The liberation of sulphur at damaged rubber surfaces can be used to form an image on a silver or copper foil, which can then be examined microscopically. A sample record and a comparison made with an ordinary microscope are given. R.W.Fish

539.213.2 : 66.041

MICROFURNACE FOR THE STUDY OF THE DEVITRIFICATION OF GLASS. See Abstr. 7524

539.217 : 539.219

8211. DIFFUSION IN MULTICOMPONENT METALLIC SYSTEMS. J.S.Kirkaldy.
Canad. J. Phys., Vol. 35, No. 4, 435-40 (April, 1957).

Onsager's phenomenological scheme for diffusion in multicomponent liquid systems is examined for suitability as a description of metallic interdiffusion. Subject to certain restrictions and approximations a set of non-linear differential equations is obtained which can be simply applied to important boundary conditions. A solution of the set for the system iron, carbon, silicon is shown to provide a good fit to Darken's experimental results. A.

539.217

8212. VOID FORMATION IN SILVER–GOLD DIFFUSION COUPLES. R.Resnick and L.L.Seigle.
J. appl. Phys., Vol. 28, No. 4, 513 (April, 1957).

The voids formed in Ag–Au diffusion couples are unusually elongated and lie in grain boundaries perpendicular to the diffusion direction. This is connected with the formation of precipitates of Ag_2O which act as centres for the condensation of vacancies. When these precipitates are decreased by reduction of the oxygen content, the void configuration is significantly altered. A.B.Lidiard

539.217

8213. DIFFUSION OF ANTIMONY OUT OF GERMANIUM AND SOME PROPERTIES OF THE ANTIMONY–GERMANIUM SYSTEM.
R.C.Miller and F.M.Smits.
Phys. Rev., Vol. 107, No. 1, 65-70 (July 1, 1957).

A rate limitation at the surface for impurity diffusion into semiconductors has previously been discussed. The rate limitation leads to a radiation-type boundary condition for the diffusion differential equation. Experiments on the diffusion of radioactive antimony out of germanium have shown that the solution to the diffusion differential equation appropriate to this boundary condition does indeed agree with the experimental data. The constant which describes the rate limitation has been measured as a function of temperature and has an activation energy close to that of the diffusion constant of antimony in germanium. The diffusion constants found in this work are in agreement with those found in other experiments in which antimony was diffused into germanium. By a proper choice of the diffusion-system geometry, an increased rate limitation was produced which provided data from which sticking coefficients and partition coefficients were calculated for the system gaseous antimony–solid germanium. These data have also been used to estimate the binding energy of an antimony atom in the germanium lattice. A.

539.217 : 537.311.33

THE INTERSTITIAL DIFFUSION OF Cu IN PbS SINGLE CRYSTALS. See Abstr. 7893

539.219 : 548.736.3

8214. X-RAY INVESTIGATION OF THORIUM–ZINC ALLOYS.
E.S.Makarov and L.S.Gudkov.
Kristallografiya, Vol. 1, No. 6, 650-6 (1956). In Russian.

The existence of the compounds $Th_{2+x}Zn$, $ThZn_2$, $ThZn_4$, $ThZn_7$, Th_2Zn_{17} is established using chemical, X-ray and phase methods. Structure types and cell dimensions are given. R.F.S.Hearmon

539.219 : 548.736.4

8215. X-RAY INVESTIGATION OF THE SYSTEM $PbTiO_3$–"$PbSnO_3$". Yu.N.Venevtsev, G.S.Zhdanov and T.N.Shendrik.
Kristallografiya, Vol. 1, No. 6, 657-65 (1956). In Russian.

Solid solutions exist in the system up to 75 mol.% "$PbSnO_3$". From 0-55 mol.% the cell is tetragonal and at higher concentrations it is rhombohedral. The phase diagram shows similarities to that of the Pb(Ti, Zr)O_3 system, but differs from that of Ba(Ti, Sn)O_3. It is suggested that the mechanism of electric polarization may differ in $BaTiO_3$ and $PbTiO_3$. R.F.S.Hearmon

539.23

8216. STRUCTURE CHANGES IN SELENIUM UNDER THE ACTION OF LIGHT. H.Stegmann.
Naturwissenschaften, Vol. 44, No. 5, 108-9 (1957). In German.

Describes the change in appearance and in optical density of a thin layer of selenium on exposure to light and on heating. A.R.Stokes

539.23 : 535.5

LIMITS OF THE POLARIMETRIC METHOD OF THIN FILM MEASUREMENTS. See Abstr. 7795

539.232

8217. SOME PROPERTIES OF OXIDE LAYERS PRODUCED ON ALUMINIUM BY ELECTROLYTIC OXIDATION.
W.C.van Geel and B.J.J.Schelen.
Philips Res. Rep., Vol. 12, No. 3, 240-8 (June, 1957).

A description is given of measurements of the thickness (d), dielectric constant (ϵ) and density (ρ) of oxide layers produced on Al by electrolytic oxidation. The X-ray investigation of the structure of these layers was also undertaken. Two different values were found for the thickness of the layer, viz. d = 13.7 A/volt and d = 12.7 A/volt. The former value was found after chemical cleaning, the latter without any prior removal of the oxide layer formed by reaction with the air. The cleaning probably causes an increase of about 7% in the surface area. If this is correct, then d = 12.7 A/volt is the more acceptable value. For ρ the value found was 3.1 g/cm^3, for ϵ the value 8.7. When it is formed at room temperature, the oxide is completely amorphous, except when a layer of boehmite has been produced on the Al by boiling it in water. In the latter case γ'-Al_2O_3 is also formed. Oxidation at 100° C always gives some γ'-Al_2O_3 as well as amorphous Al_2O_3.

539.232 : 538.245

SUPERFICIAL LAYERS ON NiZn FERRITES. See Abstr. 7232

539.234 : 537.311.31

8218. THE AGING OF EVAPORATED SILVER FILMS.
R.A.Aziz and G.D.Scott.
Canad. J. Phys., Vol. 35, No. 7, 785-91 (July, 1957).

The spontaneous ageing of thin films of silver was studied by following electrical resistance variations with time immediately after deposition in vacuo. In one series of experiments films, all deposited in a fixed time of 100 seconds and with initial resistances from 170 000 to 20 ohms, were investigated. The resistance of some films rose rapidly with time; in others it dropped rapidly, and in still others resistance changes were less pronounced. In a second series eight films were formed, all with equal initial resistances (5000 ohms) but deposited in different times. The rate of decrease in resistance was greater as the rate of deposition increased. The limiting value of resistance depended on the time of deposition. A possible qualitative explanation of the results on the basis of distortion decay and film aggregation is proposed. A.

539.27 : 537.311.33

ELECTRON DIFFRACTION STUDIES OF GERMANIUM (100) SURFACES. See Abstr. 7862

ELASTICITY. STRENGTH. RHEOLOGY

539.3/.8

539.32 : 539.371 : 534.321.9

8219. VARIATION OF ELASTIC CONSTANTS AND STATIC STRAINS WITH HYDROSTATIC PRESSURE. A METHOD FOR CALCULATION FROM ULTRASONIC MEASUREMENTS. R.K.Cook.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 445-9 (April, 1957).

The elastic constants and static strains of a solid subjected to large hydrostatic pressures can be deduced from measurements of resonant frequencies (or transit times) for ultrasonic waves in specimens of suitable crystallographic orientations. The pressure changes the specimen's size, shape, and density as well as the elastic constants, and all of the effects influence the resonant frequencies. An algorithm for separating out the effects due to variations in elastic constants from the effects due to static strains is presented and applied to cubic crystals and hexagonal crystals, these structures being of immediate interest to investigators concerned with the properties of metals. The results apply also to isotropic and transversely isotropic solids. The only measurements needed while the specimen is under hydrostatic pressure are resonant frequencies (or transit times). Also required are the size and density at zero pressure, or the elastic constants at zero pressure. A.

539.3

8220. INTERNAL FRICTION AND CRITICAL STRESS OF COPPER ALLOYS. S.Takahashi.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1253-61 (Dec., 1956).

The effects of strain amplitude on the internal friction and the Young's modulus of polycrystalline specimens of copper alloys (Cu Zn, Cu–Al, Cu–P) with various concentrations of solute atoms hav been investigated. The results are: (a) The critical stress, up to where internal friction and Young's modulus are almost independen of strain amplitude, increases with concentration of solute atoms, showing good agreement with the theoretical stress obtained by Mo (2) The strain-independent part of the internal friction decreases a a power function of concentration of solute atoms, although its numerical value depends largely on the pre-treatment. (3) The strain-dependent part of the internal friction and the fractional change of Young's modulus are represented by two parallel formula as in the theory of Nowick. But the factors of strain-dependencies seem to increase with concentration of solute atoms. (4) Internal friction and Young's modulus are both almost independent of frequency in the range between 900 and 10 000 c/s at room temperatur A

539.3

8221. ON THE MEASUREMENT AND A NEW CALCULATION OF THE DYNAMIC ELASTIC CONSTANTS OF QUARTZ.
V.G.Zubov and M.M.Firsova.
Kristallografiya, Vol. 1, No. 5, 546-54 (1956). In Russian.

Using the Schaefer–Bergmann method (1935) independent and direct measurements are made of the stiffnesses C_{11}, C_{33}, C_{44} and C_{66}. It was found necessary to apply the piezoelectric corrections of Lawson (Phys. Rev., Vol. 59, 838, 1941). Inconsistent results were obtained for C_{44} and C_{14} determined in different ways. The inconsistencies were resolved by applying the theory due to Laval (Abstr. 7313/1951, 8471/1954) and Raman–Viswanathan (Abstr. 9992/1955), and in this way a complete description of the behaviour of the crystal in dynamic processes was obtained. The final values of the constants are n_{11} = 86.6; n_{33} = 105.4; n_{44} = 58.4; n_{55} = 57.6; n_{66} = 39.6; n_{17} = 17.5 (all in 10^{10} dyn/cm^2; modified Laval notation). R.F.S.Hearmo

539.3

8222. THE EFFECT OF AGEING ON THE INTERNAL FRICTION OF PLATE GLASS AND A TEMPERATURE ANOMALY IN THE INTERNAL FRICTION OF QUARTZ GLASS. E.Deeg.
Naturwissenschaften, Vol. 44, No. 10, 303 (1957). In German.

539.373 : 548.

SLIP AND TWINNING OF ZINC CRYSTALS. See Abstr. 7484

539.373 : 538.221 : 621.318.

ELASTICITY OF VARIOUS COBALT-SUBSTITUTED FERRITI See Abstr. 8011

539.374 : 548

8223. INFLUENCE OF HETEROGENEOUS STATE OF STRESS ON THE MECHANISM OF PLASTIC DEFORMATION IN THALLIU AND CAESIUM HALIDES.
M.V.Klassen-Neklyudova and A.A.Urusovskaya.
Kristallografiya, Vol. 1, No. 4, 410-18 (1956). In Russian.

It is established experimentally that plastic deformation takes place by the occurrence of faults under a combination of shear and tension corresponding to the existence of macro-bending moments the crystallographic axis must also have a definite orientation rel tive to the deformation axis. Faults did not occur at any orientati under pure tension. R.F.S.Hearm

539.3

8224. DEFORMATION OF A FIXED-FREE BAR UNDER A COMPRESSIVE IMPACT OF SHORT DURATION. S.K.Ghosh.
Indian J. Phys., Vol. 30, No. 9, 485-6 (Sept., 1956).

Gives a quantitative explanation using the theory already deve oped by the author. The experimental data of E.T.Habib are used testing the theory. The agreement between author's theory and experiment is found to be satisfactory.

539.4.016 : 539.32 : 548

8225. MECHANISM OF DISLOCATION LOCKING IN ATTENUATION OF HIGH FREQUENCY SOUND AT LOW TEMPERATURES. T.S.Hutchison and G.J.Hutton.
Canad. J. Phys., Vol. 34, No. 12B, 1498-500 (Dec., 1956).

The internal friction peak at 155° K in pure Al, using 5 Mc/s sound waves, and enhanced by cold working (Abstr. 1919/1956), w investigated after different periods of room temperature ageing. is shown that the loop length between locking points is much too

small to account for the observed peak on the basis of a dislocation relaxation mechanism (Abstr. 7786/1955); also the peak height does not change appreciably with room temperature ageing. It is suggested that if the dislocations produced by cold work are on intersecting slip planes, the locking may be chiefly by the network so formed. H.J.H.Starks

539.4.016 : 537.311.31 : 537.323

THE THERMOELECTRIC POWER OF COPPER, SILVER AND GOLD AFTER COLDWORKING. See Abstr. 7931

539.411

8226. A COMPRESSOMETER FOR OBTAINING STRESS–STRAIN CURVES OF ROCK SPECIMENS UP TO FRACTURE.
E.R.Leeman and C.Grobbelaar.
J. sci. Instrum., Vol. 34, No. 7, 279-80 (July, 1957).

A compressometer is described by which the axial compressive strains occurring in a cylindrical rock specimen subjected to a linear axial compressive load in a compression test, can be read or recorded continuously up to the point of fracture of the specimen. The measuring elements are U-pieces to which wire resistance strain gauges are cemented. The U-pieces are built into the compressometer in such a way that when the specimen to which the compressometer is attached, fractures, they fall unharmed from the compressometer. The instrument has been used to obtain the stress–strain curves of many rock specimens without its accuracy being impaired or suffering physical damage. A.

539.42 : 539.434

8227. TESTING MACHINE FOR SHORT-TIME CREEP AND STRESS-RUPTURE TESTING AT 2000 to 2500° C.
M.C.Smith, D.M.Olson and H.L.Brown.
Rev. sci. Instrum., Vol. 28, No. 7, 543-7 (July, 1957).

A testing machine is described in which a specimen contained within a water-jacketed vessel is heated in vacuum or in a gas atmosphere by a tantalum-tube resistance heater, and is then subjected to static tensile loads up to 100 000 lb/in^2. This machine is now in routine use for short-time creep and stress-rupture testing of metallic and nonmetallic specimens at 2000 to 2500° C. With minor modifications, it can also be used for longer-period creep and stress-rupture studies, for ordinary tensile, compressive, or shear testing, and for operation at temperatures substantially above 2500° C or down to room temperature. A.

539.893 : 536.421 : 536.424

8228. INVESTIGATION OF THE POLYMORPHIC TRANSITIONS OF BISMUTH AT VERY HIGH PRESSURES.
V.P.Butuzov and E.G.Ponyatovskiĭ.
Kristallografiya, Vol. 1, No. 5, 572-6 (1956). In Russian.

The constitution diagram of bismuth was determined up to pressures of 30 000 Kg/cm^2 and from room temperature up to about 280° C. The results are correlated with those of Bridgman. Data are given on the melting points and transition temperatures of the phases and on the thermal effects and changes in specific volume accompanying the $\alpha \leftrightarrow \beta$ and $\beta \leftrightarrow \gamma$ transitions. R.F.S.Hearmon

539.893

8229. EFFECTS OF PRESSURE ON BINARY ALLOYS. III. FIVE ALLOYS OF THALLIUM, INCLUDING THALLIUM–BISMUTH.
P.W.Bridgman.
Proc. Amer. Acad. Arts Sci., Vol. 84, No. 1, 1-42 (1956).

For Pt II see Abstr. 1855 (1955). This paper contains data on pure Tl, and the systems Tl–Cd, Tl–In, Tl–Pb, Tl–Sn, Tl–Bi. Measurements usually include those of specific resistance and temperature coefficient of resistance at atmospheric pressure, volume compression up to 4 x 10^4 kg/cm^2, shearing strength up to 8 x 10^4 kg/cm^2, and of resistance change up to 10^5 kg/cm^2, all carried out at or near room temperature. F.Ansbacher

539.893

8230. EFFECTS OF PRESSURE ON BINARY ALLOYS. IV. SIX ALLOYS OF BISMUTH. P.W.Bridgman.
Proc. Amer. Acad. Arts Sci., Vol. 84, No. 1, 43-109 (1956)

The parameters measured for the alloys: Bi–Ag, Bi–Zn, Bi–Te, Bi–Sb, Bi–Pb, Bi–In, cover the same ranges as in previous investigations of other alloys. The behaviour of the alloys of Bi is generally far more complicated than those of any other alloys studied. Complications arise from the three modifications of Bi, irreversible formation of phases or compounds which themselves may show polymorphism under pressure, and absence of internal equilibrium as shown by creep in electrical resistance. F.Ansbacher

539.893

8231. EFFECTS OF PRESSURE ON BINARY ALLOYS. V. FIFTEEN ALLOYS OF METALS OF MODERATELY HIGH MELTING POINT. VI. SYSTEMS FOR THE MOST PART OF DILUTE ALLOYS OF HIGH MELTING METALS. P.W.Bridgman.
Proc. Amer. Acad. Arts Sci., Vol. 84, No. 2, 131-77, 179-216 (1957).

Measurements have been made of electrical resistance under pressures up to 100 000 kg/cm^2, plastic shearing strength to 80 000 or 100 000 and linear compressibility up to 30 000, for two groups of alloys and the pure constituents. In Pt V, 15 binary alloys, and in Pt VI 15 binary alloys, carbon steel, and three invars with different carbon contents are reported on. Altogether eleven Cu alloys were investigated; a disagreement of 5% between two previous determinations of the compression of pure Cu was resolved in favour of the 1949 value; a new type of shearing anomaly was found in Cu–Mn, Cu–Pd and Cu–Pt, involving a decrease of shear strength with increasing pressure. J.Hawgood

539.893 : 536.421.1

MELTING POINT OF INDIUM AT PRESSURES UP TO 30 000 Kg/cm^2. See Abstr. 7820

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.124 : 534.22/.23

8232. DISPERSION AND ABSORPTION OF SOUND IN LIQUIDS IN GENERAL CHEMICAL EQUILIBRIUM AND ITS APPLICATION TO CHEMICAL KINETICS. D.Tabuchi.
J. chem. Phys., Vol. 26, No. 5, 993-1001 (May, 1957).

It is shown that there occur dispersion and absorption of sound owing to chemical reaction in a liquid which is in general chemical equilibrium $aA + bB + \ldots \rightleftharpoons qQ + rR + \ldots$. From the acoustic characteristic equation, the velocity and the absorption coefficient of sound are derived, and the characteristics of the dispersion and absorption curves are examined. The velocity and the absorption coefficient, of sound in a liquid are derived in terms of the density, the static isothermal compressibility, the thermal expansion coefficient, the partial molar volume, the equilibrium constant, that is the composition, the reaction heat at constant volume, the molar heat at constant volume, and the rate constant of chemical reaction. By measuring the velocity and the absorption of sound, it is possible to determine the rate constant of chemical reaction, the reaction heat, and the volume change. The application to solutions, especially to electrolyte solutions is shown, and in this case the activity coefficients may be used. As special cases, chemical reactions which are not accompanied by reaction heat or volume change are treated, and the results of Freedman and Manes are compared with the present one, and the differences are pointed out. Several examples of the general formulae are shown. Since it is easy to increase the frequency of sound, the method of measuring the velocity and the absorption coefficient of sound is adequate for determining the rate of a very fast reaction in the equilibrium state. A.

541.124

8233. RELAXATION-TIME MODEL FOR FREE-RADICAL CONCENTRATION. J.C.Giddings.
J. chem. Phys., Vol. 26, No. 5, 1210-15 (May, 1957).

The accuracy of the quasi-equilibrium approximation in chemical kinetic studies is examined using a relaxation-time model. Two distinct cases arise: the time-lag case and the diffusion case.

In each case, the proposed model leads to exactly the same result as an approximate mathematical treatment. The kinetic processes in a flame front are examined, and are shown to involve both the time-lag and diffusion cases. Again, the model is justified by an independent approximate method. The model is next examined in that region of the flame where the kinetic processes are most important, that is, near the point of maximum reaction rate. A very simple expression is found for the radical concentration at this point. This expression is justified through numerical examples. A.

541.124

8234. MECHANISM OF FORMATION OF PENTABORANE-9 FROM PENTABORANE-11. R.Schaeffer.
J. chem. Phys., Vol. 26, No. 5, 1349 (May, 1957).

It is suggested that the traces of hydrogen, always quickly formed in vessels containing boron hydrides, react thus with pentaborane-11

$$B_5H_{11} + H_2 \rightleftharpoons B_4H_{10} + \tfrac{1}{2}B_2H_6.$$

Then follows

$$B_4H_{10} + B_5H_{11} \rightarrow B_5H_9 + B_2H_6$$

which is shown to provide a satisfying explanation of all important equilibria and kinetics of conversion of diborane to B_4H_{10}, B_5H_{11} and B_5H_9. W.Good

541.124 : 536.2.02

THERMAL CONDUCTIVITY OF GAS MIXTURES IN CHEMICAL EQUILIBRIUM. See Abstr. 7810

541.124 : 537.311.33

THE OXIDATION OF METALS. See Abstr. 7878

541.126

8235. ACTIVATION ENERGY OF HYDROGEN-ABSTRACTION REACTIONS. R.E.Dodd.
J. chem. Phys., Vol. 26, No. 5, 1353-4 (May, 1957).

Data are collected for the activation energies of reactions of the type

$$CF_3 + RH = CF_3H + R \quad (E_f)$$

and compared with those of

$$CH_3 + RH = CH_4 + R \quad (E_m)$$

It is noted that generally $E_m > E_f$, and that $E_m - E_f = 6.4 - 0.64\,E_f$. This proportionality is discussed. W.Good

541.126

8236. INVESTIGATIONS ON THE REDUCTION OF SILVER SULFIDE AND CUPROUS SULFIDE BY HYDROGEN.
H.Kobayashi and C.Wagner.
J. chem. Phys., Vol. 26, No. 6, 1609-14 (June, 1957).

The rate of removal of sulphur from silver sulphide and cuprous sulphide at 300 and 385°C, respectively, has been determined as a function of the metal activity in the sulphide with the help of electrochemical measurements. From the results, it is concluded that hydrogen molecules react mainly with sulphur atoms adsorbed on Ag_2S but with sulphur ions adsorbed on Cu_2S. The significance of the results for the interpretation of catalytic reactions is discussed. A.

541.126

8237. MECHANISM OF THE GAS PHASE, THERMAL DECOMPOSITION OF OZONE. S.W.Benson and A.E.Axworthy,Jr.
J. chem. Phys., Vol. 26, No. 6, 1718-26 (June, 1957).

The pyrolysis of ozone has been reinvestigated experimentally, and it is now shown that most of the known data are quantitatively explained on the basis of the simple mechanism,

$$M + O_3 \overset{1}{\rightleftharpoons} M + O_2 + O$$

$$O + O_3 \overset{3}{\rightarrow} 2\,O_2,$$

where M may be O_2, O_3, CO_2, N_2, He, etc. There is no evidence for a direct bimolecular reaction of ozone to produce O_2 nor is there any evidence for important surface effects or energy chains. On the other hand, the results at very fast rates of decomposition indicate an acceleration which can be accounted for in terms of temperature gradients in the system. This region is usually very close to the thermal explosion limit. The values found for the rate constants are (for M equal to O_3),

$k_1 = 4.61 \pm 0.25 \times 10^{12} \exp(-24\,000/RT)$ litre/mole-sec,
$k_2 = 6.00 \pm 0.33 \times 10^{7} \exp(+600/RT)$ litre^2/mole^2-sec,
$k_3 = 2.96 \pm 0.21 \times 10^{10} \exp(-6000/RT)$ litre/mole-sec.

The relative efficiencies of O_2, N_2, CO_2, and He in activating O_3 (compared to O_3 itself) are, respectively, 0.44, 0.41, 1.06 and 0.34. As expected for energy transfer processes, k_1 has an abnormally high pre-exponential factor, and k_2 has correspondingly a negative energy of activation. It is further inferred that Reaction 3 which produces two O_2 molecules with 99 kcal of excess energy between them does not produce more than one excited electronic state of O_2 and that these hot O_2 molecules are not very efficient in exciting O_3 to decomposition. Calculations of the entropy of activation of Reaction 1 can be made and are shown to be in good agreement with this conclusion. From these findings it appears that the high quantum yields found in the photolysis of O_3 at short wavelengths, if real, probably are attributable to metastable O atoms [^{1}D] produced in the primary process which can generate chains in O_3. It can be shown that the homogeneous production of O atoms from O_2 at high temperatures proceeds through two different paths having different activation energies, the lower energy path involving O_3 as an intermediate. Finally, possible mechanisms are considered for the chemical sensitization of the thermal explosion of O_3 and its catalytic decomposition by H donors. A.

541.126

8238. REACTION OF CARBON MONOXIDE AND OZONE. P.Harteck and S.Dondes.
J. chem. Phys., Vol. 26, No. 6, 1734-7 (June, 1957).

This reaction has been investigated at 35°, 100°, 180° and 258°C. It could be shown that there is an initial period where the reaction proceeds an order of magnitude faster than after some carbon dioxide is formed. Further oxidation of carbon monoxide by ozone proceeds in the order of magnitude of the thermal decomposition of ozone. A.

541.126

8239. KINETIC STUDY OF THE OXIDATION OF URANIUM DIOXIDE S.Aronson, R.B.Roof,Jr and J.Belle.
J. chem. Phys., Vol. 27, No. 1, 137-44 (July, 1957).

Oxidation of UO_2 to U_3O_8 in dry air and oxygen at temperatures of 180 to 350°C proceeds by a two-step reaction. In the first step the tetragonal oxide of composition $UO_{2.34 \pm 0.03}$ is formed. In the second step this tetragonal phase is converted to orthorhombic U_3O_8. The rate controlling process in the first stage is the diffusion of oxygen through the uranium dioxide lattice. The value found for the diffusion coefficient D is

$$D = 5.5 \times 10^{-3} \exp[-(26\,300 \pm 1500)/RT],$$

where the activation energy is 26.3 ± 1.5 kcal/mole. The second stage of the reaction proceeds by a process of nucleation and growth. A.

541.126 : 535.333

LUMINOUS REACTION BETWEEN CARBON MONOXIDE AND ATOMIC NITROGEN. See Abstr. 7730

541.126 : 535.343

ULTRAVIOLET ABSORPTION SPECTRA AND THE CHEMICAL MECHANISM OF CS_2–O_2 EXPLOSIONS. See Abstr. 7739

541.128 : 537.311.33

CATALYSIS AND SURFACE PROPERTIES OF SEMICONDUCTING CRYSTALS. See Abstr. 7874-6

ELECTROCHEMISTRY 541.13

541.133

8240. THEORY OF THE FIELD STRENGTH EFFECT OF STRONG ELECTROLYTES. H.Falkenhagen and H.Ulbricht.
Naturwissenschaften, Vol. 44, No. 9, 277 (1957). In German.

The calculation of the effect (the result of which is given) is based on the Debye–Hückel–Onsager theory of strong electrolytes. Within experimental error the observed variation of the equivalent conductivity with field strength for $Ba_2[Fe(CN)_6]$ at 18°C and a concentration of 0.00156 equivalents per litre of solution is in agreement with theory. W.Good

541.13

8241. ON THE ELECTROREDUCTION OF ANIONS.
A.N.Frumkin and N.V.Nikolajeva.
J. chem. Phys., Vol. 26, No. 6, 1552-3 (June, 1957).

The electroreduction of anions is often strongly influenced by the electronic charge on the surface of the metallic electrode, and this influence can be traced to the influence of the charge on the composition of the electrical double layer. Experiments cited by others as tending to disprove this supposition are shown to be in fact compatible with it. Neutral molecules containing coordinated chlorine behave with respect to electroreduction much like anions

because the chlorine assists in the adsorption of the molecule, and this adsorption is charge sensitive. In all cases the difference in the mechanism of the electroreduction of anions or of neutral particles with anionic groups at different potentials can be interpreted as determined by differences in the conditions of adsorption of the reacting particles. A.

541.138.2

8242. DISCONTINUITIES IN THE FORMATION CURVE GRADIENTS DURING THE ANODIC OXIDE LAYER FORMATION ON ALUMINIUM AND TANTALUM FROM AQUEOUS ELECTROLYTES (PRELIMINARY COMMUNICATION). G.Ulrich.
Wiss. Z. Hochsch. Elektrotech. Ilmenau, Vol. 3, No. 1, 65-7 (1957). In German.

Discontinuities in the formation curves of anodic deposits are held to arise from uneven changes in electronic field strength over the Helmholtz double-layer at the phase boundary. The abrupt changes are due to extra release of electrons from the electrolyte anions which abnormally increase the field strength as the thickness of the deposit increases. H.H.Hodgson

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14

8243. STUDIES OF I ATOM AND Br ATOM RECOMBINATION FOLLOWING FLASH PHOTOLYSIS OF GASEOUS I_2 AND Br_2. R.L.Strong, J.C.W.Chien, P.E.Graf and J.E.Willard.
J. chem. Phys., Vol. 26, No. 5, 1287-95 (May, 1957).

The method of flash photolysis has been used to determine the rate constant, k, in the expression $d(X_2)/dt = k(X)^2M$ for the combination of iodine atoms in argon, and of bromine atoms in argon oxygen, and nitrogen. At room temperature nitrogen is approximately 1.3 and oxygen 2.2 times as effective as is argon in serving as a "third body" for the combination of bromine atoms. Measurements of the rate constants at a series of temperatures up to 160° give apparent activation energies of −1.4 kcal/mole for I in A, −2.0 kcal/mole for Br in A and −1.2 kcal/mole for Br in O_2. The $(I_2)/(A)$ ratios used in the iodine atom studies were in the range of the "tail" of the $(I_2)/(A)$ v. k plot of the Cambridge group and the k values are in agreement with their results. Estimates of the maximum "thermal effect" possible in the bromine atom studies, compared with the experimental results, indicate that such effects were probably negligible. Experimental tests and calculations of the effect of nonuniform illumination of the reaction cell by the flash lamp indicate that the observed rate constants are quite insensitive to this factor. A.

541.14

8244. PHOTON PROPAGATED CHAIN REACTIONS AND THE SHORT WAVELENGTH PHOTOLYSIS OF OZONE. S.W.Benson.
J. chem. Phys., Vol. 26, No. 5, 1351-2 (May, 1957).

It is suggested that one of the excited (oxygen) species produced in the reaction $O_3 + h\nu$ itself emits radiation at about 2000 A thus giving rise to a photon propagated chain reaction since O_3 has a very high absorption coefficient for this radiation. W.Good

541.14

8245. VACUUM ULTRAVIOLET PHOTOCHEMISTRY. V. NITROUS OXIDE AT 1236 A. M.Zelikoff and L.M.Aschenbrand.
J. chem. Phys., Vol. 27, No. 1, 123-4 (July, 1957).

For Pt IV, see Abstr. 826 (1957). The photolysis of nitrous oxide has been studied using krypton resonance radiation at 1236 A. The mechanism is found to differ from that at 1470 A and at 1849 A since the initial absorption act at 1236 A probably proceeds in a dual manner. One way leads to production of nitrogen atoms and nitric oxide molecules while the other produces nitrogen molecules and oxygen atoms. The mechanisms at the three wavelengths are unified into one consistent picture. A.

541.15

8246. PROTON RESONANCE IN NEUTRON AND GAMMA-IRRADIATED POLYETHYLENE. N.Fuschillo and J.A.Sauer.
J. chem. Phys., Vol. 26, No. 5, 1348-9 (May, 1957).

The broadening of the proton resonance line of polyethylene on neutron irradiation is attributed to cross-linking and hindering of molecular motions as opposed to increased crystallinity. D.H.Whiffen

541.15

8247. DECOMPOSITION OF CARBON DIOXIDE BY IONIZING RADIATION. II. P.Harteck and S.Dondes.
J. chem. Phys., Vol. 26, No. 6, 1727-33 (June, 1957).

For Pt I, see Abstr. 6579 (1955). Work was continued at pressures from 1 atm to 50 atm, and on liquid carbon dioxide at 10° C, near the critical temperature. Also a novel method was developed in using the direct impact of the fission fragments on the gases (U^{235} in contact with the gases on bombardment with thermal neutrons). The action of inhibitors other than nitrogen dioxide to stop the back reaction of the decomposed carbon dioxide was also investigated. Since the decomposition of nitrous oxide by ionizing radiation was determined as a dosimeter, parallel decomposition experiments were conducted with the nitrous oxide and carbon dioxide under identical conditions. The G values of the carbon dioxide decomposition were determined with and without inhibitors at high pressures and the liquid state by pile radiation and by the impact of fission fragments. The G values ranged from 0.005 to 8.5 ± 0.5 depending upon conditions. The basic mechanism described in Pt I was confirmed. No difference in behaviour was noticed in the gas phase when irradiated with pile radiation or fission fragments. In the liquid state, it could be shown that the "hot spots" or "hot needles" along the ionization track of the fission fragments are not "hot" enough to initiate the thermal decomposition, which in the case of nitrous oxide requires a heat of activation of 53 kcal and for carbon dioxide 128 kcal. However, two markedly different behaviours between the gaseous and liquid states were noted. First, the inhibitors became inefficient in the liquid carbon dioxide phase, and second, the G value for the decomposition of liquid carbon dioxide was found to be 4 to 5. These behaviours are not altered if the liquid carbon dioxide is irradiated with normal pile radiation or with fission fragments. A.

541.15 : 539.21

LOW-TEMPERATURE REACTOR IRRADIATION EFFECTS IN METALS. See Abstr. 8205

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.182.3 : 537.226.2

DIELECTRIC CONSTANT OF SOLID PARTICLE AEROSOLS. See Abstr. 7844

541.183.2

8248. INTERACTION OF RARE GASES WITH GRAPHITE. A.D.Crowell.
J. chem. Phys., Vol. 26, No. 6, 1407-8 (June, 1957).

The interaction energies and frequencies of vibration of neon, argon, krypton, and xenon atoms over the surface of a basal plane of graphite have been calculated, assuming a (6-12) potential between the gas atoms and carbon atoms in the graphite lattice. The graphite lattice is approximated by a set of planes of uniform distribution of matter. The significance of the results is discussed briefly. A.

541.183.2

8249. ENTROPY OF CHEMISORBED HYDROGEN. T.Takaishi and A.Kogayashi.
J. chem. Phys., Vol. 26, No. 6, 1542-4 (June, 1957).

The vibrational entropy of chemisorbed hydrogen is analyzed and the frequencies of its vibration parallel to the surface are obtained as to hydrogen on reduced nickel, reduced copper, and platinum-black. The activation energies for migration are estimated from these frequencies. They are of the right order for nickel and copper but not for platinum-black. The latter fact proves that the active centres for adsorption are sparsely distributed over the surface of platinum-black. This method of investigation of vibrational state is complementary to that by infrared spectroscopy. A.

CHEMICAL STRUCTURE 541.2/.6

541.57 : 537.533.74

INFLUENCE OF CHEMICAL BONDS ON ATOMIC SCATTERING OF ELECTRONS. See Abstr. 7954

541.67 : 537.311.33

A "SEMICONDUCTOR BOND". See Abstr. 7890

CHEMICAL ANALYSIS 543/545

545.1 : 531.752

8250. AN APPARATUS GIVING THERMOGRAVIMETRIC AND DIFFERENTIAL THERMAL CURVES SIMULTANEOUSLY FROM ONE SAMPLE. D.A.Powell.
J. sci. Instrum., Vol. 34, No. 6, 225-7 (June, 1957).

A description is given of modifications to a Chevenard thermobalance which enable it to record simultaneously, but on separate charts, both thermogravimetric and differential thermal curves of a single sample undergoing thermal decomposition. A method of placing temperature marks on both charts is also described. Some records obtained and the performance of the apparatus are briefly discussed. A.

545.7

8251. THE DETERMINATION OF CARBON DIOXIDE IN AIR [BY TITRATION METHODS]. A.Brukl and L.Balcarczyk.
Acta phys. Austriaca, Vol. 10, No. 3, 198-205 (1956). In German.

545.8 : 537.311.33

IMPURITY DETERMINATION IN SILICON. See Abstr. 7882

545.827

8252. NEW METHOD FOR THE DETERMINATION OF URANIUM, RADIUM, THORIUM AND ACTINIUM IN MINUTE PARTICLES OF A RADIOACTIVE MINERAL. G.Becquerel.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 137A-142A (Nov., 1956). In French.

The method used is to study the absorption of the α-particle spectrum and its growth after prolonged heating to volatilize the active deposit. A.O.Stanesby

CRYSTALLOGRAPHY 548

548.1

8253. RATIONAL METHOD OF CALCULATING VARIOUS CLOSE SPHERICAL PACKINGS. V.V.Bakakin and N.V.Belov.
Kristallografiya, Vol. 1, No. 5, 491-4 (1956). In Russian.

A simplified method is given for obtaining the general number of close spherical packings with a period of n layers; numerical calculations are carried out for n = 13, 14. R.F.S.Hearmon

548.1 : 537.226.1

8254. FERROELECTRIC PHASE TRANSITIONS AND CRYSTAL SYMMETRY. I.S.Zheludev and L.A.Shuvalov.
Kristallografiya, Vol. 1, No. 6, 681-8 (1956). In Russian.

A complete tabulation is made of the crystal symmetries of possible ferroelectric phases corresponding with a given symmetry and direction in the initial phase. R.F.S.Hearmon

548.232 : 548.736.3

8255. ON THE POLYGONIZATION OF ROCK SALT CRYSTALS. S.Hosoya, S.Satake and S.Takagi.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1228-31 (Dec., 1956).

Ionic crystals can be plastically bent under water to a great extent. This phenomenon has been known as Joffé effect, the mechanism being not fully elucidated. In the present work the X-ray diffraction method and etch pit techniques have been used in order to investigate the arrangement of crystallites in the bent and annealed rock salt. Both results show, with good correspondence, that the crystal consists of many polygonized crystallites which have the form like letter L, with small angle boundaries between the neighbours. The mean thickness of these crystallites was about 0.02-0.03 mm, when the radius of curvature of bending was about 20 mm. A.

548.232 : 548.7

8256. ON THE POLYGONIZED DOMAIN PATTERN IN BENT AND ANNEALED NaCl CRYSTALS VISUALIZED BY COLOUR CENTRE COLLOIDS. S.Hosoya.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1231-6 (Dec., 1956).

Colour centre colloids have been used to make visible the dislocation networks in ionic crystals. The polygonization boundaries inside the crystal are also clearly seen by the decoration effect of the colloids. It has been found that these boundaries are usually L shaped in the strongly bent and annealed crystals. The polygonized structure agrees well with the results derived from etch pits and X-ray diffraction. Polygonized boundaries were found to appear in the direction perpendicular to the glide planes when the crystal is annealed at 600° C or higher. A.

548.5

8257. FIBROUS GROWTH OF $NaClO_3$. G.W.Sears.
J. chem. Phys., Vol. 26, No. 6, 1549-52 (June, 1957).

It has been observed by Kato (Abstr. 1726/1956) that fine fibres of $NaClO_3$ form on moist massive crystals of $NaClO_3$ which are slowly desiccated. It is proposed that the growth occurs by a uniaxial screw dislocation mechanism in which the material transport occurs by hydrodynamic flow in an adherent film of solution on the fibre surface. The tractive force for film flow is furnished by a gradient in surface tension. The film solution becomes more concentrated during its flow to the fibre tip and the gradient in solute concentration causes a gradient in surface tension. The estimated film thickness is about 100 A. Periodic bends in the fibre can be accounted for by periodic precipitation of a minor impurity with limited solid solubility in $NaClO_3$. A.

548.52

8258. SYNTHESIS OF MONOCRYSTALS OF DOUBLE SULPHATE OF GUANIDINE AND ALUMINIUM. J.Chapelle and B.Chollot.
C.R. Acad. Sci. (Paris), Vol. 244, No. 9, 1185-7 (Feb. 25, 1957). In French.

The effects of low concentrations of foreign ions on the crystallization of guanidine aluminium sulphate hexahydrate from acidic aqueous solutions has been investigated. It is suggested that $Cr_2(SO_4)_3$ at a concentration 0.01 mole/litre reduces cracking and improves the electrical properties. L.E.Cross

548.52

8259. ON THE PRODUCTION OF SINGLE CRYSTALS OF NAPHTHALENE AND ANTHRACENE. F.R.Lipsett.
Canad. J. Phys., Vol. 35, No. 3, 284-98 (March, 1957).

Furnaces for the growth of naphthalene (m.p. 80° C) and anthracene (m.p. 217° C) crystals from the melt by the Bridgman method are described and discussed. The advantages of long furnaces are emphasized. A seeding technique may be used to produce long crystals, and has been successful in producing naphthalene crystals $2\frac{1}{2}$ feet long. A technique for polishing the crystals which gives flat, smooth surfaces is described. Methods of determining the orientation of the crystals by cleavage and by examination of the isogyres or birefringence in a polarizing microscope are given. A simple method for producing anthracene crystals by recrystallization from solution in N,N-dimethylformamide is given, and apparatus for producing very thin sublimation crystals of anthracene is described. The procedures may also be employed to produce mixed crystals. A.

548.52

8260. A METHOD OF GROWING CdS SINGLE CRYSTALS BY SUBLIMATION. S.Ibuki and K.Awazu.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1297 (Dec., 1956).

CdS powder heated to 1050-1150° C is evaporated on to a cooled tube at 900-1000° C with N_2 as carrier gas. After a few hours, crystals 10-20 mm long, 2-10 mm wide are obtained as thin plates and ribbons. J.Frank

548.52 : 548.7

8261. FORMATION OF SPIRAL DISLOCATIONS IN THE PROCESS OF CRYSTAL GROWTH. G.G.Lemmlein and E.D.Dukova.
Kristallografiya, Vol. 1, No. 3, 351-5 (1956). In Russian.

The formation of spiral dislocations in the growth of para-toluidine and naphthalene is filmed and described in detail. R.F.S.Hearmon

548.52

8262. THE APPROACH OF TWO SPIRAL CENTRES OF DIFFERENT SIGNS IN THE PROCESS OF CRYSTAL GROWTH.
G.G.Lemmleĭn and E.D.Dukova.
Kristallografiya, Vol. 1, No. 4, 477-8 (1956). In Russian.
Ciné films of the motion relative to one another of two spiral centres of opposite sign on paratoluidene are reproduced and discussed. R.F.S.Hearmon

548.52 : 548.7

8263. SPIRAL GROWTH LAYERS ON BARIUM TITANATE CRYSTALS. N.V.Gliki, I.A.Pleteneva and V.A.Timofeeva.
Kristallografiya, Vol. 1, No. 5, 607-8 (1956). In Russian.
Observations on a spiral growth with rectangular contours are reported and related to the domain structure. R.F.S.Hearmon

548.57

8264. GROWING OF ORGANIC PHOSPHORS FOR SCINTILLATION COUNTERS.
R.Bhattacharyya, U.B.Roy and S.Chatterjee.
Indian J. Phys., Vol. 30, No. 12, 585-9 (Dec., 1956).
A simple furnace has been designed and constructed for growing organic phosphor crystals. Conditions for good crystal growth are discussed. A.

ATOMIC AND X-RAY CRYSTALLOGRAPHY

548.7

548.7

8265. A SIMPLE FORMULA FOR EVALUATING THE MADELUNG CONSTANT OF AN NaCl-TYPE CRYSTAL.
J.K.Mackenzie.
Canad. J. Phys., Vol. 35, No. 4, 500-1 (April, 1957).
A direct proof of Benson's formula (Abstr. 7840/1956) is given. A.R.Stokes

548.7

8266. COUPLING OF OPTIC AND ACOUSTIC MODES OF VIBRATION IN CRYSTALS. E.Bauer.
J. chem. Phys., Vol. 26, No. 6, 1440-4 (June, 1957).
The transition probability for transfer of energy from one optic to two or three acoustic modes of vibration has been calculated for sodium chloride, and found to be of the order 10^{12} per sec at low temperatures. A.

548.7

8267. ELASTIC AND FORCE CONSTANTS OF A SIMPLE TETRAGONAL CRYSTAL. G.B.Mitra and B.V.Gokhale.
J. chem. Phys., Vol. 26, No. 6, 1655-6 (June, 1957).
Lattice vibrations of a monoatomic simple tetragonal crystal have been discussed and interactions of first, second, third, and fourth nearest neighbours have been taken into account. The equations of motion of an atom along the three crystallographic axes have been set up. Comparing with these the corresponding equations of elastic vibrations, the elastic constants of the simple tetragonal lattice have been expressed in terms of the various force constants and vice versa. Free electrons in the lattice have been supposed to give rise to an additional force constant which has also been evaluated in a similar way. A.

548.7

8268. VIBRATION SPECTRUM OF GRAPHITE AND BORON NITRIDE. II. THE THREE-DIMENSIONAL SPECTRUM.
G.F.Newell.
J. chem. Phys., Vol. 27, No. 1, 240-50 (July, 1957).
A detailed analysis of the spectrum of graphite and boron nitride that began in Pt I (Abstr. 5522/1956) with a description of the two-dimensional spectrum neglecting the interaction between layers is completed here with the inclusion of the coupling between layers. Of particular interest is the low-frequency end of the spectrum which is distorted by the coupling in such a way as to cause a significant change in the thermodynamic behaviour of the system at sufficiently low temperatures. Although most of the qualitative features of the spectrum have been described elsewhere, it is shown here that it is actually possible to find analytic approximations to the Born–von Kármán spectrum within well-defined limits of accuracy. The lack of experimental measurements of the elastic constants and other relevant data, however, makes any quantitative calculation of specific heat very difficult although it is apparent that the model is capable of explaining qualitatively the peculiar properties of these highly anisotropic crystals. A.

548.7 : 539.185

8269. INELASTIC SCATTERING OF SLOW NEUTRONS BY LATTICE VIBRATIONS IN ALUMINUM.
R.S.Carter, H.Palevsky and D.J.Hughes.
Phys. Rev., Vol. 106, No. 6, 1168-74 (June 15, 1957).
The lattice vibrations of aluminium have been studied by means of the inelastic scattering of "cold" neutrons, in which the neutron absorbs a phonon whose energy is typically much larger than the incident neutron energy. Neutrons with a wavelength about 5 A were obtained by filtering a beam of thermal neutrons through eight inches of beryllium. After scattering in an aluminium single crystal, the neutron energy distribution was determined by time of flight, using a mechanical chopper. The peaks observed in the energy distribution of the scattered neutrons for various crystal orientations were used to determine the "scattering surface" in a plane parallel to one face of the cubic lattice. The scattering surface gives the dispersion law for the crystal, that is, the frequency, ω, of the lattice vibration phonons as a function of the wave, $\vec{q}$. Dispersion curves, obtained for three different directions in the crystal, agree well with X-ray results and with theoretical calculations of the dispersion based on the assumption of harmonic forces. A.

548.7

8270. CHARACTERISTIC TEMPERATURES OF CUBIC METALS.
E.E.Budzinski and H.Schiff.
Canad. J. Phys., Vol. 35, No. 5, 507-11 (May, 1957).
An approximation is developed for the determination of the characteristic Debye temperatures of cubic crystals. This method yields results more accurate than those obtained by Bhatia and Tauber (Abstr. 6699/1957) using Houston's three-term formula and slightly more accurate than those obtained with the more recent six-term formula of Betts, Bhatia, and Wyman (Abstr. 1733/1957) and also provides a means of estimating the accuracy of these formulae. A.

548.7

8271. X-RAY INVESTIGATION OF THE DEFORMATION AND BOND STRENGTH IN THE CRYSTAL LATTICE OF METALS AND ALLOYS. G.V.Kurdyumov, V.A.Il'ina, V.K.Kritskaya and L.I.Lyĭsak.
Izv. Akad. Nauk. SSSR, Ser. fiz., Vol. 17, No. 3, 297-312 (1953).
In Russian. English translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 673 (1957).
The line broadening and intensity changes of diffraction lines are discussed in relation to lattice distortions. Static displacements of atoms from ideal sites affect line intensities in a manner similar to thermal vibrations. A distinction between the static and the dynamic (thermal motion) displacements of atoms can be made by taking X-ray photographs at two or more temperatures. This method of investigations was applied to the study of iron and steel. J.Adam

548.7 : 538.221

8272. CATION ARRANGEMENT AND MAGNETIC PROPERTIES OF COPPER FERRITE-CHROMITE SERIES.
S.Miyahara and H.Ohnishi.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1296-7 (Dec., 1956).
X-ray investigations gave the dependence of the relative numbers of Cu ions on tetrahedral and octahedral lattice sites for a range of values of Cr content c. The variation with c of the Curie temperature and saturation magnetization was also obtained. E.P.Wohlfarth

548.7 : 548.24

8273. THE STRUCTURE OF KINK BANDS IN SOME IONIC CRYSTALS. E.V.Kolontsova, I.V.Telegina and G.M.Plavnik.
Kristallografiya, Vol. 1, No. 4, 419-24 (1956). In Russian.
The kink bands in sheared monocrystals of CsI and TlI–TlCl were investigated by narrow pencil X-ray scanning following preliminary investigation in polarized light. The relation between twinning and the occurrence of internal kink bands is also discussed. R.F.S.Hearmon

548.7

8274. INVESTIGATION OF THE FORMATION OF KINK BANDS IN THALLIUM HALIDE CRYSTALS.
M.V.Klassen-Neklyudova and A.A.Urusovskaya.
Kristallografiya, Vol. 1, No. 5, 564-71 (1956). In Russian.
Optical and X-ray studies on three TlBr–TlI specimens of different orientation gave complete agreement. The bands may develop perpendicular to the shear planes, but may also accompany unsymmetrical rotation of the lattice. R.F.S.Hearmon

548.7 : 539.219

8275. LATTICE DISTORTION IN TERMINAL SOLID SOLUTIONS OF THE FIRST LONG PERIOD TRANSITION METALS AND COPPER. W.B.Pearson.
Canad. J. Phys., Vol. 35, No. 4, 358-62 (April, 1957).

Collected data of the gross lattice distortion in solid solutions of the first long period elements in each other, and in copper are given together with similar data for B-group solutes in Cu, Ag, and Au. It is shown that there is no correlation between the size of the lattice distortion and the solid solubility of the first long period transition metals in copper. A.

548.7

8276. MANGANESE IMPURITIES IN SILVER HALIDES [AgCl, AgBr] STUDIED BY THE PARAMAGNETIC RESONANCE ABSORPTION. H.Abe.
J. Phys. Soc. Japan, Vol. 12, No. 4, 435 (April, 1957).

548.7

8277. ON THE QUESTION OF THE NATURE OF THE COLOUR CENTRES OF SMOKY QUARTZ. L.G.Chentsova.
Kristallografiya, Vol. 1, No. 4, 484-5 (1956). In Russian.

Reviews recent work and explains some of the effects observed when an electric current is passed through smoky quartz. R.F.S.Hearmon

548.7 : 537.226.2

BEHAVIOUR OF THE DOMAINS OF ROCHELLE SALT IN ALTERNATING ELECTRIC FIELDS. See Abstr. 7847

548.7 : 537.226.2

EFFECT OF Co^{60} IRRADIATION ON ROCHELLE SALT. See Abstr. 7848

548.7 : 537.311.33

DISLOCATIONS IN DIAMOND-TYPE LATTICES. See Abstr. 7884

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73

8278. A SIMPLE ARRANGEMENT FOR OBTAINING OPTICAL TRANSFORMS OF CRYSTAL STRUCTURES. C.Aravindakshan.
J. sci. Instrum., Vol. 34, No. 6, 250 (June, 1957).

Describes a method for obtaining transforms that employs only one lens (3 in. diameter, focal length 40 in.). The mask is prepared photographically, the gelatin in the transparent portions of the plate being etched off to obviate diffraction effects due to variations in the thickness of the gelatin layer. J.Thewlis

548.733

8279. SINGLE CRYSTAL OSCILLATION PHOTOGRAPHS ABOUT THREE CRYSTALLOGRAPHIC AXES FROM A SINGLE SETTING ON A WEISSENBERG CAMERA. J.Shankar and P.G.Khubchandani.
J. sci. Instrum., Vol. 34, No. 6, 228-9 (June, 1957).

Gives the design of a cam and its mounting to enable oscillation photographs to be taken about the three crystallographic axes from a single crystal setting. The modification is particularly useful with crystals of radioactive substances or those having undeveloped faces. A.

548.733

8280. A METHOD OF STABILIZING THE SPECIMEN TEMPERATURE FOR SINGLE CRYSTAL X-RAY CRYSTALLOGRAPHY. D.E.Henshaw.
J. sci. Instrum., Vol. 34, No. 7, 270-1 (July, 1957).

Describes a method for the automatic control of the specimen temperature in a single crystal X-ray goniometer for the growth and examination of crystals down to -130°C. The principle may also be useful for other temperature ranges. A.

548.733 : 537.542

8281. SPECIALIZATION OF THE APPARATUS FOR THE DETERMINATION OF THE INTENSITIES OF X-RAY REFLECTIONS WITH THE AID OF GEIGER COUNTERS.
Ya.I.Graevskaya, V.I.Iveronova and V.P.Tarasova.
Kristallografiya, Vol. 1, No. 4, 442-5 (1956). In Russian.

The equipment is assembled from standard items and can be used to measure the intensities of diffracted lines with reflection angles between 5 and 74°. R.F.S.Hearmon

548.733

8282. X-RAY DIFFRACTOMETER AND ITS APPLICATION TO THE SOLUTION OF SOME PROBLEMS OF X-RAY ANALYSIS.
D.M.Kheĭker and L.S.Zevin.
Kristallografiya, Vol. 1, No. 6, 739-63 (1956). In Russian.

A review with 115 references. R.F.S.Hearmon

548.733

8283. AN ADJUSTABLE X-RAY LOW-ANGLE CAMERA OF SIMPLE CONSTRUCTION. H.Fiedler.
Naturwissenschaften, Vol. 44, No. 4, 85-6 (1957). In German.

The camera is made almost entirely of rectangular metal blocks. It can resolve periodicities up to 2000 A. A.R.Stokes

548.734

8284. USE OF DIRECT METHODS OF X-RAY STRUCTURAL ANALYSIS IN CRYSTALLOCHEMICAL INVESTIGATIONS.
Z.V.Zvonkova.
Kristallografiya, Vol. 1, No. 6, 631-3 (1956). In Russian.

The methods can be applied to complex compounds containing 60 atomic parameters. R.F.S.Hearmon

548.734.2 : 548.734.5

8285. INVESTIGATION OF POORLY FORMED MONOCRYSTALS OF UNKNOWN SYMMETRY BY MEANS OF AN X-RAY GONIOMETER. É.Shandor.
Kristallografiya, Vol. 1, No. 6, 677-80 (1956). In Russian.

A method using a single Laue diagram on cylindrical film is given for determining zone axis in crystals. R.F.S.Hearmon

548.734.5

8286. X-RAY GONIOMETRIC METHODS OF INVESTIGATING CRYSTALS. M.M.Umanskiĭ and D.M.Kheĭker.
Kristallografiya, Vol. 1, No. 4, 446-59 (1956). In Russian.

A review dealing with photographic and ionization registration. R.F.S.Hearmon

548.735

8287. STRUCTURAL TYPES IN THE CLOSE PACKING OF ATOMS. POSSIBLE STRUCTURAL TYPES WITH COMPOSITION AB_4. N.L.Smirnova.
Kristallografiya, Vol. 1, No. 5, 502-5 (1956). In Russian.

Earlier work (Abstr. 6734/1957) is extended to include compounds of the type AB_4. R.F.S.Hearmon

548.735

8288. PROCEDURE FOR PRECISE DETERMINATION OF THE DISPLACEMENT OF A REFLECTION IN X-RAY STRAIN MEASUREMENTS. G.K.Schmidt.
Naturwissenschaften, Vol. 44, No. 5, 107-8 (1957). In German.

The displacement is more accurately obtained by first correcting the profile of the displaced line for broadening by Stokes's method (Abstr. 4039/1948). A.R.Stokes

548.735.4

8289. A FOURIER ANALOGUE-COMPUTER OF THE HÄGG—LAURENT TYPE. V.Frank.
J. sci. Instrum., Vol. 34, No. 5, 210-11 (May, 1957).

548.736.1

8290. PHASE TRANSITION TEMPERATURE OF POLONIUM. J.M.Goode.
J. chem. Phys., Vol. 26, No. 5, 1269-71 (May, 1957).

The phase-transition temperatures of polonium have been measured using X-ray diffraction. Transition of α to β polonium occurs at $54^{\circ}C \pm 1.5^{\circ}C$ and the β to α transition occurs at $18^{\circ}C \pm 1.5^{\circ}C$. The special sample mount used is described. A.

548.736.1

8291. SPACE GROUP OF TELLURIUM AND SELENIUM. R.H.Asendorf.
J. chem. Phys., Vol. 27, No. 1, 11-16 (July, 1957).

A group theoretical analysis is given for the symmetry of the crystal structure and Brillouin zone of tellurium and selenium. This is of particular interest because of the presence in the crystal of a threefold screw axis. Character tables for the group of the wave vector are given for various points of the Brillouin zone. Both the single group and the spin double group are treated. Compatibility relations are given. A.

548.736.3 : 539.219

8292. THE LATTICE SPACINGS OF NICKEL SOLID SOLUTIONS. W.B.Pearson and L.T.Thompson.
Canad. J. Phys., Vol. 35, No. 4, 349-57 (April, 1957).

New lattice spacing measurements in terminal nickel solid

solutions with Cr, Mn, Co, Zn, Ga, Ge, In, and Sn solutes are reported and discussed, and the relationship of lattice distortion and the depression of the solidus temperature is examined in solid solutions of the first long period elements in nickel. A.

548.736.3 : 539.133

8293. B–Cl DISTANCE IN BORON TRICHLORIDE.
M.Atoji and W.N.Lipscomb.
J. chem. Phys., Vol. 27, No. 1, 195 (July, 1957).

An X-ray diffraction study of a single crystal of BCl_3 has yielded a B–Cl distance of 1.75 ± 0.02 A. A.

548.736.3 : 539.133

8294. CRYSTAL AND MOLECULAR STRUCTURE OF DIBORON TETRACHLORIDE, B_2Cl_4.
M.Atoji, P.J.Wheatley and W.N.Lipscomb.
J. chem. Phys., Vol. 27, No. 1, 196-9 (July, 1957).

B_2Cl_4 is a planar molecule, Cl_2BBCl_2, with a B–Cl distance of 1.73 ± 0.02 A and a B–B distance of 1.75 ± 0.05 A. The crystal structure is orthorhombic, with four molecules in a unit cell of dimensions a = 11.90 A, b = 6.28 A, and c = 7.69 A. The space group, D_{2h}^{15}–P bca, requires that the molecules be centrosymmetric. A.

548.736.3 : 539.133

8295. CRYSTAL AND MOLECULAR STRUCTURE OF B_9H_{15}.
R.E.Dickerson, P.J.Wheatley, P.A.Howell and W.N.Lipscomb.
J. chem. Phys., Vol. 27, No. 1, 200-9 (July, 1957).

With only the information that B and H alone are present, and that the melting point is −20°, the molecular structure of B_9H_{15}, a new boron hydride, has been determined from single crystals by X-ray diffraction methods. There are four molecules in the unit cell, space group $P2_1/n$, with a = 11.80 A, b = 6.94 A, c = 11.25 A, and $\beta = 109°9'$. The boron skeleton, solved by three-dimensional Patterson and trial and error methods, and refined by least squares methods, is a fragment of the icosahedron formed by removing three connected borons not forming an equilateral triangle. Hydrogen atoms, located from three-dimensional difference maps, agree with those expected from previously known boron hydrides. The overall agreement factor is $R = \Sigma||F_o| - |F_C||/\Sigma|F_o| = 0.155$. Computations on the Univac computer are described briefly, with emphasis on the use of fractional shifts of parameters in the least squares method. A least squares normalized weighted sum of squares of residuals is proposed as a better criterion of agreement than R. A.

548.736.3 : 539.133

8296. LEAST SQUARES REFINEMENTS OF $B_{10}H_{14}$, B_4H_{10}, AND B_5H_{11}. E.B.Moore, Jr, R.E.Dickerson and W.N.Lipscomb.
J. chem. Phys., Vol. 27, No. 1, 209-11 (July, 1957).

New interatomic distances in $B_{10}H_{14}$, B_4H_{10}, and B_5H_{11} indicate that the B–B distances which are more strongly bound in the simplified valence theory are slightly shorter than other B–B distances. The position of the unique hydrogen atom in B_5H_{11} is now somewhat more satisfactory in relation to the plane of symmetry of the isolated molecule. The improvement of agreement of observed and calculated X-ray intensities suggests that lease squares refinements as usually applied are not carried through enough iterations. A.

548.736.3

8297. MICROSCOPIC AND X-RAY STUDIES ON TUNGSTEN OXIDE (WO_3). S.Sawada.
J. Phys. Soc. Japan, Vol. 11, No. 12, 1246-52 (Dec., 1956).

The domain structure of single crystals of tungsten oxide was observed between −130°C and 1200°C. An abrupt change of domain structure was observed at −50°C on cooling and it varied only gradually on heating. No change was observed at the 910°C transition. The crystal structure was investigated in detail near 910°C and 1230°C respectively. No change of crystal symmetry except for only slight anomalies of lattice constants was observed at these two transitions. Ferroelectricity or antiferroelectricity and bond structure of this substance are discussed using the result of observations, and it was stressed that these would be in an intimate relation with each other. A.

548.736.3 : 536.413

8298. X-RAY DETERMINATION OF THE CONSTANTS OF THE CRYSTAL LATTICE AND THE COEFFICIENTS OF THERMAL EXPANSION IN LEUCO-SAPPHIRE AND RUBY.
N.A.Shal'nikova and I.A.Yakovlev.
Kristallografiya, Vol. 1, No. 5, 531-3 (1956). In Russian.

For α- Al_2O_3 the cell dimensions a and c in kX units are given up to 1000°C by

$$a = 4.747 + 2.8 \times 10^{-5}t + 9.7 \times 10^{-9}t^2,$$
$$c = 12.955 + 8.0 \times 10^{-5}t + 2.3 \times 10^{-8}t^2,$$

where t is the temperature in deg C. The mean coefficients of expansion at 500°C are $\beta_\perp = 7.1 \times 10^{-6}$, $\beta_{||} = 7.0 \times 10^{-6}$. For α-Al_2O_3 containing 9.6% Cr_2O_3, the mean coefficients at 500°C are $\beta_\perp = 7.2 \times 10^{-6}$, $\beta_{||} = 8.2 \times 10^{-6}$. A curve is given showing the dependence of the a dimension on Cr_2O_3 content up to 50% Cr_2O_3. R.F.S.Hearmon

548.737

8299. THE CRYSTAL STRUCTURE OF ANTHRACENE AT DIFFERENT TEMPERATURES. G.S.R.Krishna Murti.
Indian J. Phys., Vol. 30, No. 11, 537-42 (Nov., 1956).

The crystal structure of anthracene at −180°C, 32°C, 55°C and 80°C has been investigated by studying the Debye–Scherrer patterns. It is found that at a temperature of about −180°C the dimensions of the unit cell are given by a = 8.547 A, b = 6.000 A, c = 11.090 A and $\beta = 125°10'$. These values a, b and c being slightly lower than those at the room temperature. The mean values of α_a, α_b and α_c, the coefficients of expansion along the three crystallographic axes a, b and c respectively are found to be 77.5×10^{-6}, 27.52×10^{-6} and 31.05×10^{-6} respectively. The dimensions of the unit cell of the crystal at 80°C are a = 8.696 A, b = 6.150 A, c = 11.310 A and $\beta = 124°28'$. It appears that the coefficient of expansion is low up to about 55°C but a tenfold increase in the values takes place in the range from 55°C to 80°C. The values for α_a, α_b and α_c in the range from 32°C to 80°C are 32.55×10^{-5}, 39.36×10^{-5} and 27.45×10^{-5} respectively. A.

548.737

8300. THE CRYSTAL STRUCTURE OF DIPHENYL AT DIFFERENT TEMPERATURES. G.S.R.Krishna Murti.
Indian J. Phys., Vol. 31, No. 1, 1-5 (Jan., 1957).

The dimensions of the unit cell of the crystal of diphenyl at 32°C and −180°C were determined by taking the Debye–Scherrer patterns at those temperatures. The unit cell dimensions at 32°C are a = 8.29 A, b = 5.82 A, c = 9.48 A and $\beta = 94°41'$; and at −180°C, a = 7.98 A, b = 5.70 A, c = 9.37 A and $\beta = 95°21'$. The coefficients of expansion α_a, α_b and α_c along the three crystallographic axes a, b and c in the range −180°C to 32°C are 18.33×10^{-5}, 9.93×10^{-5} and 5.54×10^{-5} respectively. The small change in the angle of β at −180°C is attributed to a small rotation of molecules in the unit cell. It is pointed out that the larger contraction along a-axis is consistent with the orientation of the molecules in the unit cell. A.

548.74

8301. ON DETERMINING THE CHARACTER OF THE SCATTERING OF ELECTRONS (DYNAMIC OR KINEMATIC) IN ELECTRON DIFFRACTION INVESTIGATIONS.
B.K.Vaĭnshteĭn and A.N.Lobachev.
Kristallografiya, Vol. 1, No. 4, 472-3 (1956). In Russian.

The importance of distinguishing between dynamic and kinematic scattering in electron diffraction structural investigations is pointed out and the difference between the two is illustrated with reference to results on urea. R.F.S.Hearmon

548.74

8302. ELECTRON DIFFRACTION DETERMINATION OF THE STRUCTURE OF ANTIMONY TELLURIDE. S.A.Semiletov.
Kristallografiya, Vol. 1, No. 4, 403-6 (1956). In Russian.

Sb_2Te_3 is found to be hexagonal, with a = 4.24 ± 0.02 kX; c = 29.90 ± 0.10 kX. R.F.S.Hearmon

548.74

8303. ACCURACY OF THE FOURIER SERIES OF POTENTIALS IN ELECTRON DIFFRACTION CRYSTALLOGRAPHY.
B.K.Vaĭnsteĭn
Kristallografiya, Vol. 1, No. 5, 495-501 (1956). In Russian.

A formula is derived for mean square errors in the potentials and tables and graphs given to facilitate the calculations.
R.F.S.Hearmon

548.74 : 539.234

8304. ELECTRON DIFFRACTION INVESTIGATION OF THE STRUCTURE OF GERMANIUM FILMS PRODUCED BY VACUUM DEPOSITION. S.A.Semiletov.
Kristallografiya, Vol. 1, No. 5, 542-5 (1956). In Russian.

The dependence of the structure of sublimated films of germanium on the character of the substrate, the temperature, the velocity of deposition and the thickness of the film was investigated. Different types of orientation were found, connected with the original flatness of the substrate and with the rectilinearity of propagation of the atoms. The possibility of producing highly oriented films by deposition on single-crystal germanium is discussed.
R.F.S.Hearmon

548.74

8305. A NEW PHASE STRUCTURE OF MOLYBDENUM.
P.S.Aggarwal and A.Goswami.
Proc. Phys. Soc. B, Vol. 70, Pt 7, 708-10 (July, 1957).

Electron diffraction photographs of Mo which was deposited in vacuo from a pure Mo wire filament indicated the presence of a face-centred cubic modification. Such a modification, which has not previously been reported, has a unit cell-side of 4.16 A, that of the body-centred cubic variety being 3.141 A. J.Thewlis

GEOPHYSICS 55

550.312 : 518.5

8306. GRAVITY ANOMALY SIMULATOR.
J.A.F.Gerrard, L.Strickland, A.L.Wade and H.K.Reynolds.
Rev. sci. Instrum., Vol. 28, No. 6, 438-42 (June, 1957).

An instrument that will simulate the anomalous gravity effects of a subsurface body, having a density differing from that of its surroundings, is described. The device makes use of the similarity between the gravity equation and Lambert's cosine θ law, and enables the geophysicist to synthesize the anomaly producing body in a time much shorter than that required for conventional computational methods. The accuracy that can be expected is $\pm 5\%$ of the maximum anomaly within limitations noted. A.

550.384 : 551.594.5 : 523.75

8307. JODRELL BANK OBSERVATIONS OF GEOPHYSICAL PHENOMENA FOLLOWING THE SOLAR FLARE OF 1956 FEBRUARY 23. M.Dagg, R.W.Vice and C.D.Watkins.
Jodrell Bank Ann., Vol. 1, No. 4, 104-15 (Dec., 1956).

Observations of radio-star scintillations, auroral radio echoes and geomagnetic field variations were made at Jodrell Bank following the unusual solar flare of February 23 1956. The results are compared with those for another aurora which occurred a week later and which was not preceded by an increase in cosmic-ray intensity. The geomagnetic disturbances following the unusual solar flare are little different from normal disturbances. The 27-day recurrence of magnetic storms during the period February to April 1956 is also discussed. A.

551.1 : 539.501

8308. RHEOLOGY OF THE EARTH. THE BASIC PROBLEM OF GEODYNAMICS. A.E.Scheidegger.
Canad. J. Phys., Vol. 35, No. 4, 383-97 (April, 1957).

A discussion is given of the data which are available to provide information on the rheological behaviour of the earth's mantle and crust. It is shown that a fundamental distinction has to be made between stress durations that are "short" (up to 4 hours), "intermediate" (4 hours to 15 000 years), and "long" (longer than 15 000 years). For short durations, the behaviour of the earth is well known from the results of seismological investigations. However, these results should not be applied directly to the longer time durations. For intermediate time durations, the earth shows an elastic after-effect. One obtains a value for the (Kelvin) viscosity if it is assumed that the damping of the variation of latitude is caused by a Kelvin effect. The same (Kelvin) viscosity is arrived at if the strain rebound characteristics of earthquake after-shock sequences are also interpreted in terms of an elastic after-effect. For stresses of long duration, some information may be obtained from the uplift of Fennoscandia. It appears that viscous creep is the prevailing phenomenon. If this information is combined with some further considerations, indications are that the earth behaves like a Bingham body. Then, the fact that orogenetic phenomena are concentrated in narrow bands may be due to the existence of solutions of the Bingham equation exhibiting rheological instability. A.

551.24

8309. THE FRACTURE ZONES OF OROGENESIS.
R.O.A.Robinson.
Canad. J. Phys., Vol. 35, No. 5, 536-54 (May, 1957).

A brief discussion of existing theories of orogenesis leads on to a consideration of the mode of propagation of a series of primary arcs. One such series constitutes a system, and it is suggested that the great orogenetic belts are best understood in terms of subdivisions into such systems. Explanations are given of the secondary structures and of the observed features at junctions between pairs of arcs and between pairs of systems. Among the latter the most notable are extensive, shallow transcurrent faults. In the past these have been analyzed in terms of states of stress persisting over long periods of time. It is suggested that this is incorrect and that they result from splay-faulting during the formation of the junction. It is shown that their character and strike are entirely determined by the relative age of the arcs forming the junction. Since echelon structure represents simply a series of such small transcurrent faults, it follows that it reveals completely the order of growth (through time) of a given primary arc. The resulting conclusions are in good agreement with the known geology, and it is felt that the methods derived will help to clarify considerably the orogenetic development of systems only imperfectly mapped to date. Reversed arcs are thought to occur only at junctions between two systems as distinct from junctions between two primary arcs of the same system. A.

ATMOSPHERE. METEOROLOGY 551.5

551.510.534 : 551.593.5

8310. THE RELATION BETWEEN AN UMKEHR CURVE AND THE VERTICAL DISTRIBUTION OF ATMOSPHERIC OZONE.
G.F.Walton.
Quart. J. Roy. Meteorol. Soc., Vol. 83, 173-80 (April, 1957).

An expression is derived for the intensity-ratio for two wavelengths in the ultraviolet (one, but not the other, strongly absorbed by ozone) or primary scattered sunlight received from the zenith at the base of a plane-stratified atmosphere. The logarithm of the intensity-ratio is expanded in a series which reveals the nature of the relation between it and the vertical distribution of atmospheric ozone. By evaluating a few terms of the series, "umkehr" curves (which depict the variation of the log intensity-ratio with the solar zenith distance) are constructed for several typical vertical distributions. Two umkehr curves are found to be almost identical, except in the region corresponding to low altitudes of the sun, although they arise from markedly dissimilar vertical distributions of ozone. The information on the vertical distribution given by zenith observations when the sun is high in the sky is discussed. A.

551.510.535

8311. WORLDWIDE OCCURRENCE OF SPORADIC E.
E.K.Smith, Jr.
Circ. Nat. Bur. Stand., No. 582, 278 pp. (1957).

Detailed analysis of Es on a worldwide basis, combining the results obtained from vertical incidence pulse measurements and from field strength measurements for v.h.f. oblique incidence propagation. Considerations are given to the structure of the Es region, classification of Es types, ionosonde scaling conventions and power-dependence of fEs, temporal and geographical variations, height of occurrence, frequency-dependence of occurrence and correlations with magnetic activity. Three major Es zones (Equatorial, Temperate and Auroral) are distinguished on the basis of the temporal Es characteristics, the Equatorial zone being recognized only on the daytime side of the earth. Possible energy sources of Es are considered, and it is concluded that they are terrestrial for Temperate zone Es, extra-terrestrial (solar corpuscles) for Auroral zone Es, and related to the equatorial electrojet for Equatorial zone Es. G.M.Brown

551.510.53

8312. FADING AND RANDOM MOTION OF IONOSPHERIC IRREGULARITIES. S.N.Mitra and R.B.L.Srivastava.
Indian J. Phys., Vol. 31, No. 1, 20-42 (Jan., 1957).

Describes the results of the statistical analysis of fading curves obtained at Delhi on transmission from the medium-wave transmitter at Lucknow operating on 1020 kc/s. The different types of fading commonly experienced and their possible causes are discussed. The irregular types of fading, which formed the material for analysis, are shown to be caused by either a random motion of the ionospheric irregularities or by superposition of a steady signal upon the

randomly varying one. It has been shown that the probability distribution of the former is given by a Rayleigh curve and that of the latter by a normal law of error. The relative proportion of the random and the steady components in the case of a Gaussian distribution of amplitude has been calculated. The "time-analysis" of the fading curves reveals the r.m.s. velocity in the line-of-sight of the random motion of the ionospheric irregularities and is found to lie between 4 and 25 m/sec. Booker, Ratcliffe and Shinn had studied the problem of fading from a diffraction process of an irregular screen representing the ionosphere. Their analysis has been used in the present paper to deduce the r.m.s. velocity of the ionospheric irregularities based on auto-correlation function and the power spectrum of the received wave. It is found that the values of the r.m.s. velocity deduced from the two methods are in substantial agreement. The effect of steady drift, location and the dimension of irregularities in the ionosphere causing the irregular fading are also discussed. A.

551.510.535

8313. RECOMBINATION COEFFICIENT AND ELECTRON PRODUCTION RATE FROM TOTAL ELECTRON CONTENT IN UNIT COLUMN BELOW THE LEVEL OF MAXIMUM IONISATION. S.Datta.
Indian J. Phys., Vol. 31, No. 1, 43-52 (Jan., 1957).

Describes the results of computation of the mean recombination coefficient ($\bar{\alpha}$) and the mean electron production ratio ($\bar{q}$) in the F-region on quiet days. The diurnal variation of n, the total number of electrons in a column of unit cross-section extending from the "bottom" to the maximum ionization density height of the same region is utilized for the purpose. The values of n and its diurnal variation, in their turn, are computed from the P'–f records of the automatic ionospheric recorder installed at Haringhata (Calcutta). Night-time average values of $\bar{\alpha}$ obtained by the same method, show a marked seasonal change, the maximum being in December ($\bar{\alpha} = 10.8 \times 10^{-10}$ cm^3 sec^{-1} per electron) and the minimum in June ($\bar{\alpha} = 2.2 \times 10^{-10}$ cm^3 sec^{-1} per electron). Assuming that the recombination coefficient falls off at an exponential rate, $\alpha_m e^{-pz}$ (where z is the reduced height, α_m is the recombination coefficient at the maximum ionization height and p is a constant), a method has been suggested for determining the value of p from the recombination rate in the unit column and that at the maximum ionization density height. A.

551.510.535

8314. THE IONOSPHERIC F_2 LAYER OVER AHMEDABAD, DELHI AND TIRUCHIRAPALLI DURING THE SUNSPOT MINIMUM PERIOD (1953-54). K.M.Kotadia.
J. sci. industr. Res., Vol. 15A, No. 12, 543-50 (Dec., 1956).

Account of the general characteristics of the F2 layer over Ahmedabad (geomagnetic latitude 13.6°N) determined from hourly h'f records. Results are compared with those obtained at Delhi and Tiruchirapalli. The diurnal and seasonal variations of foF2, h'F2 and hpF2 are discussed, with particular reference to the sunrise effect and the occurrence of F2-scatter echoes and stratifications. G.M.Brown

551.510.535 : 523.78

8315. IONOSPHERIC CHANGES AT SINGAPORE DURING THE SOLAR ECLIPSE OF 20 JUNE 1955. C.M.Minnis.
J. atmos. terrest. Phys., Vol. 10, No. 4, 229-36 (1957).

Measurements were made, at vertical incidence of the changes in the ionosphere which accompanied the eclipse. It has been possible to derive the distribution and intensities of the solar sources of ionizing radiation responsible for the E layer during the eclipse. Although it would not have been obscured at Singapore, it has been necessary to postulate the existence of a bright source in the sun's southern hemisphere having an intensity equal to 21% of the total radiation. This figure agrees well with the intensity (23%) derived from measurements made on the control days, of a source of radiation associated with an active group of spots which was in the south-west quadrant on 20 June. No significant change occurred in the F2-layer critical frequency during the eclipse, but the temporary appearance of an F1½ layer, in addition to the usual permanent ledge in the F2 layer, indicates that the eclipse was responsible for a rearrangement of the electron distribution in the lower part of the F2 layer. A.

551.510.535 : 523.746

8316. THE ELECTRON DENSITY IN THE F2 LAYER AND ITS CORRELATION WITH THE SOLAR ACTIVITY. F.Mariani.
J. atmos. terrest. Phys., Vol. 10, No. 4, 239-42 (1957).

Brief account of some results obtained from a study of monthly median values of foF2 for 20 observatories and their relation to sunspot numbers, and areas of hydrogen filaments and flocculi. A geomagnetic asymmetry in the solar cycle changes appears to correlate with a similar asymmetry in the seasonal variation of electron density, and may be related to the unknown general circulation of the high atmosphere. G.M.Brown

551.510.535 : 523.164

8317. A CONSIDERATION OF RADIO STAR SCINTILLATIONS AS CAUSED BY INTERSTELLAR PARTICLES ENTERING THE IONOSPHERE. I. DAILY AND SEASONAL VARIATIONS OF THE SCINTILLATION OF A RADIO STAR. G.A.Harrower.
Canad. J. Phys., Vol. 35, No. 5, 512-21 (May, 1957).

An analysis is made of measurements of the scintillations of the radio source in Cassiopeia recorded at Ottawa during 1954 at a frequency of 50 Mc/s. After removal of the effect of the altitude of the source, the data show certain daily maxima occurring at solar times dependent on the date of the year. These maxima are found to comprise five separate groupings, two being present roughly from September 13 to March 30, and the other three for the remainder of the year. The obvious lack of circular symmetry suggests a cause external to the solar system, such as the infall of interstellar particles. The apparent directions of arrival of these particles are derived from the scintillation measurements. A.

551.510.535 : 523.164

8318. A CONSIDERATION OF RADIO STAR SCINTILLATIONS AS CAUSED BY INTERSTELLAR PARTICLES ENTERING THE IONOSPHERE. II. THE ACCRETION OF INTERSTELLAR PARTICLES AS A CAUSE OF RADIO STAR SCINTILLATIONS. G.A.Harrower.
Canad. J. Phys., Vol. 35, No. 5, 522-35 (May, 1957).

The analysis of measurements of radio star scintillations (preceding abstract) is interpreted to be the result of the accretion of interstellar particles by the sun's gravitational field. After a brief general discussion of the accretion process, the measurements are examined in an attempt to provide an explanation on that basis. Five distinct features exhibited by the scintillation data are interpreted as resulting from particles arriving at the earth as follows: directly from interstellar space, from a collision region behind the sun (both directly and after having crossed the earth's orbit), and from the collision region by a process of accretion in the gravitational field of the earth. The velocities of certain of these particles are derived by simple applications of vector addition employing the known velocity of the earth. The collision region is calculated to be located a radial distance of 200 million miles from the sun. A.

551.510.535 : 523.164

8319. A CONSIDERATION OF RADIO STAR SCINTILLATIONS AS CAUSED BY INTERSTELLAR PARTICLES ENTERING THE IONOSPHERE. III. THE KIND, NUMBER, AND APPARENT RADIANT OF THE INCOMING PARTICLES. G.A.Harrower.
Canad. J. Phys., Vol. 35, No. 7, 792-8 (July, 1957).

In Pt I and II (preceding abstracts) it was suggested that interstellar particles, captured by the gravitational field of the sun, contributed to the observed features. Arguments presented here lead to the conclusion that such particles must be hydrogen atoms. The number of hydrogen atoms reaching the earth is estimated to be 6×10^{16}/m^2/sec. Their energy averages 9 or 22 electron volts, depending on whether or not they are ionized. It is concluded that the effect of this infall on the earth's ionosphere would be more than adequate to produce scintillations. The location of the radiant, subject to the possibility of some considerable error, is judged to be right ascension 17 hours, declination −30°. Based on this position of the radiant, the velocity of the interstellar hydrogen atoms in the vicinity of the sun is found to have the components: tangential 28×10^4 m/sec, radial 2×10^4 m/sec, and transverse 0.2×10^4 m/sec, with respect to the plane of our galaxy. A.

551.510.535

8320. THE Q.L. — Q.T. TRANSITION LEVEL. D.Lepechinsky.
J. atmos. terrest. Phys., Vol. 10, No. 4, 243-4 (1957).

Additional note to author's paper (Abstr. 9073/1956) concerned with the phenomenon of reflection of a wave at the Q.L.— Q.T. transition level. G.M.Brown

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.1

8321. INSOLATION MEASUREMENTS AT POONA DURING THE SOLAR ECLIPSE ON 14 DECEMBER 1955.
P.Jagannathan, O.Chacko and S.P.Venkiteshwaran.
Indian J. Meteorol. Geophys., Vol. 8, No. 1, 93-8 (Jan., 1957).

The intensity of direct solar radiation at maximum phase

(magnitude of eclipse, 0.56) was reduced by 57%. Pyrheliometer measurements with colour filters, just prior to max. phase (0.55 of disk eclipsed), gave the following results for the reduced intensity of direct radiation in three spectral regions viz. blue, (0.35-0.65 μ : 1.2-2.8 μ), 45.3% : yellow, (0.45-2.8 μ), 39.9% : red, (0.60-2.8 μ), 41.3%. D.R.Barber

551.521.3

8322. SOME COMMENTS ON TWO ARTICLES BY TAYLOR AND YATES. J.W.Birkeland, D.E.Burch and J.H.Shaw.
J. Opt. Soc. Amer., Vol. 47, No. 5, 441 (May, 1957).

The data for transmission of extremely long paths in the atmosphere in the spectral region 0.5-15μ published by Taylor and Yates (Abstr. 1775; 5760/1957) are shown to yield valuable information on otherwise inaccessible atmospheric problems. A spectroscopic determination of the concentration of N_2O at ground level under a variety of weather conditions is possible, and there is evidence of a higher temperature of the ozone in the lower atmosphere. G.M.Brown

551.521.6

8323. EXPERIMENTAL DETERMINATION OF ATMOSPHERIC INFRA-RED RADIATION. J.L.Gergen.
Nature (London), Vol. 179, 36-7 (Jan. 5, 1957).

Radiosonde flights carrying a new total-radiation instrument, the "black ball", were made near Minneapolis; this instrument indicates a temperature which is proportional to the total (up plus down) radiation of all frequencies incident upon the body at any altitude. Since the black ball is spherical the resulting equivalent radiation temperature is not quite that for a horizontal disk but the difference between the indicated radiation temperature and the air temperature at some altitude is directly proportional to the radiative cooling (or warming) of the atmosphere at that point. Monthly averages for air and radiation temperatures from Feb. to Oct. were obtained while those for Feb. and Aug. are given in diagrams to show the seasonal extremes. In Feb. the atmosphere is everywhere cooled by radiation but in Aug. an extensive region near the tropopause is being warmed. Radiation temperatures on clear nights disagree with those obtained from the Elsasser chart with a considerably smaller actual loss of energy to space. It is suggested that the radiation charts require revision. See also Abstr. 7883 (1956). R.S.Read

551.521.6

8324. EXPERIMENTAL DETERMINATION OF ATMOSPHERIC INFRA-RED RADIATION.
A.W.Brewer and J.T.Houghton; J.L.Gergen.
Nature (London), Vol. 179, 978 (May 11, 1957).

See preceding abstract. The "black ball" radiometer method used by Gergen to measure atmospheric radiation is considered to be unreliable because the temperature of the black ball is obtained by the relation $\left(\frac{U_z + D_z}{2\sigma}\right)^{1/4}$, neglecting the spherical effects, where U_z is the upward, and D_z the downward stream of radiation. In effect he measures the places where a black body, and not the air would be heated or cooled. Further calculations of radiation flux at high levels are subject to humidity data and there is no reference to the humidity used or the variation in CO_2 path lengths. In reply Gergen questions the accuracy of measurement of U and D but he agrees the radiation chart requires revision. A more detailed reply is to be given elsewhere. R.S.Read

551.578.11

8325. PHOSPHORUS ISOTOPES P^{32} AND P^{33} IN RAIN WATER.
D.Lal, N.Narasappaya and P.K.Zutshi.
Nuclear Physics, Vol. 3, No. 1, 69-75 (March, 1957).

Marquez and Costa (Abstr. 2988/1956) detected P^{32} (half-life $\cong$ 14 days) in rain water and they attributed its presence to the spallation of atmospheric argon nuclei by cosmic rays. The present authors have detected, in rain water, the second short lived radioisotope P^{33} (half-life $\cong$ 25 days). Approximate concentrations (atoms ml^{-1} of rain water) of the two isotopes have been obtained; both are present in comparable amounts. The observed concentrations agree in order of magnitude with those reported by Marquez and Costa for P^{32}. They agree also with a rough estimate based on the number of disintegrations produced in the atmosphere by cosmic radiation and the estimated cross-section for this reaction. A simultaneous determination of the concentrations in rain water of these chemically identical radioactive nucleides, may prove valuable in meterorological studies. It may be useful for tracing the large scale motion of air masses. A.

BIOLOGY 57/59

MEDICAL SCIENCE.

HUMAN PHYSIOLOGY 61

578.087.9

8326. OPTICAL AND INSTRUMENTAL LIMITATIONS TO THE ACCURACY OF "OXIMETRY". R.H.Kay and R.V.Coxon.
J. sci. Instrum., Vol. 34, No. 6, 233-6 (June, 1957).

An "oximeter", intended primarily for measuring colorimetrically the oxygenation of circulating blood in living tissues, has been tested on blood contained in glass absorption cells. The instrument reading is shown to depend not only on oxygenation but also on the total amount of pigment (haemoglobin) in the light path, and thus a single calibration curve is only acceptable if this amount is constant. Comparison of the optical density of whole blood with a sample in which the haemoglobin has been released from the corpuscles into homogeneous solution reveals the large contribution to the total light extinction which derives from scattering effects in whole blood. This factor, together with instrumental deficiencies, limits severely the accuracy of measurements with this type of oximeter on blood within the circulation, and the accuracy of the method on whole blood in glass absorption cells is estimated as $\pm$8% oxygen saturation. A.

578.088.5 : 534.321.9

ULTRASONIC RECORDING OF THE BONES IN A HUMAN ARM. See Abstr. 7694

612.843.2

8327. ON THE RESPONSE OF THE HUMAN EYE TO LIGHT STIMULI PRESENTING A SPATIAL OR TEMPORAL GRADIENT OF LUMINANCE. L.Ronchi and G.Toraldo di Francia.
J. Opt. Soc. Amer., Vol. 47, No. 7, 639-42 (July, 1957).

The authors discuss the results of the experiments on vision of spatial and temporal gradients of luminance. There is some evidence that the cone mechanism is responsible for the vision of Mach bands on the other hand it appears both from measurements in the peripheral retina and from electroretinographic investigation that the rod system contributes to the sensation of higher brightness of the graded field. A possible relation is pointed out between the phenomena occurring in the vision of a field with a spatial gradient of luminance and the vision of a field with a temporal gradient of luminance. A.

612.843.2

8328. LIGHT ENERGY AND BRIGHTNESS SENSATION. R.W.G.Hunt; R.G.Hopkinson.
Nature (London), Vol. 179, 1026, 1026-7 (May 18, 1957).

For previous work see Abstr. 3865 (1957). Hopkinson's empirical relation between sensation and physical luminance is shown to have a theoretical basis.

Reply by R.G.Hopkinson: There is evidence to suggest that the agreement between theory and experiment is limited in extent.

R.A.Weale

612.842.3

8329. ON THE FREQUENCY VARIATION OF THE PUPILLARY LIGHT REFLEX. R.Wagner and A.Bleichert.
Naturwissenschaften, Vol. 44, No. 7, 227-8 (1957). In German.

The area of the pupil was measured as a function of the frequency of intermittent stimulation (0.067-2 c/s). A mean curve shows a decrease from 7 to 2 mm^2, accompanied by a phase delay of from approximately 5 to 240°.

R.A.Weale

612.843.612

8330. VISUAL CONTRAST THRESHOLDS FOR MOVING POINT SOURCES. G.van den Brink and M.A.Bouman.
J. Opt. Soc. Amer., Vol. 47, No. 7, 612-18 (July, 1957).

Over a wide range of brightness of the adapting field, for different colour combinations of stimulus and adapting field, contrast thresholds for moving point sources are measured, as a function of the length of the covered track, for different exposure times. When the brightness B of the adapting field does not exceed certain limits, the experimental results agree with the quantum theory of vision, when the known behaviour of the summative properties of the retina is taken into account. For backgrounds with high brightness level, deviations from this description occur. These deviations are probably due to increasing saturation of the activated nerve fibers and decrease of the concentrations of rhodopsin with increasing brightness of the adapting field. The importance of these effects differs for stimuli of various lengths and exposure times. A.

612.844.23

8331. AXIAL CHROMATIC ABERRATION OF THE HUMAN EYE. R.E.Bedford and G.Wyszecki.
J. Opt. Soc. Amer., Vol. 47, No. 6, 564-5 (June, 1957).

Subjective measurements were made of the axial chromatic aberration in 12 observers, the wavelength range extending from 389-700 mμ. The data agree closely with those of Wald and Griffin (Abstr. 2735/1947) and were used for the design of an achromatizing triple lens. Additional measurements with this lens showed that aberration was reduced from about 3 to 0.25 dioptres. R.A.Weale

612.846

8332. TELEVISION IMAGES. T.G.Crookes.
Nature (London), Vol. 179, 1024-5 (May 18, 1957).

When a televised image is viewed by an eye moving from a point about 10° to the left of the screen to an analogous position on the right more than one image can be seen. This is explained as being due to eye-movements. Predictions made on this basis were fulfilled experimentally. R.A.Weale

612.85

8333. INTERESTING EFFECT PRODUCED BY TWO LOUDSPEAKERS UNDER FREE SPACE CONDITIONS. R.L.Hanson and W.E.Kock.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 145 (Jan., 1957).

The experiments described involve the feeding of an audio-signal into two loudspeakers (in an anechoic room) one of which has its polarity reversed (polarity reversal might be looked upon as a time delay which is dependent on frequency). A person standing at equal distances from and facing the two loudspeakers received the impression that the sound was coming from a point inside or very close to his head, and as he moved to and fro sideways, the sound seemed to move about behind his head. In the present note an attempted explanation is given which invokes a null point in the plane of symmetry lying midway between the loudspeakers, the two ears of the observer lying on either side of it. The simple explanation however does not entirely meet the case for high frequency sounds of wavelengths small compared with the ear-separation of the observer.

A.B.Wood

612.85

8334. INAPPLICABILITY OF THE THRESHOLD CONCEPT TO DETECTION OF SIGNALS IN NOISE. R.R.McPherson.
J. Acoust. Soc. Amer., Vol. 29, No. 1, 151 (Jan., 1957).

The interval of observation time needed for a threshold measurement cannot be considered as an instant, and when the signal is noisy, the detailed character of the noise waveform must be taken into account. D.J.Hall

612.85

8335. AUDITORY ADAPTATION. J.F.Jerger.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 357-63 (March, 1957).

The apparent decline in the ear's response under sustained stimulation, a phenomenon which has been variously labelled "auditory fatigue", "perstimulatory fatigue", and "auditory adaptation", was measured for pure tones over a wide range of frequencies and intensities by the median-plane-localization method. For a given intensity, increasing the frequency from 125 to 1000 c/s increased both the initial rate and maximum amount of adaptation. Above 1000 c/s further increases in frequency did not appreciably change the adaptation curves. For a given frequency, increasing the intensity of the sustained stimulus also increased both initial rate and maximum amount of adaptation. The function relating adaptation (in dB) to stimulus intensity was, in general, negatively accelerated. The duration of sustained stimulation at which adaptation reached a maximum value was related to both frequency and intensity. A.

612.85

8336. MONITORING TASK IN SPEECH COMMUNICATION. J.P.Egan.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 482-9 (April, 1957).

Some communication situations involve several noisy channels, and only certain ones of these carry relevant information to a given communication operator. The operator must receive and identify a restricted number of different messages, and he must ignore others. The performance of the listener in this situation will depend both on the discriminability of the messages and on the listener's criterion for accepting his response as correct or rejecting it as incorrect. The present paper gives a quantitative description of the monitor's behaviour in terms of the operating characteristic and the articulation-criterion function. The results of two experiments are reported. In one of these, the confusion matrices for the various sets of messages were also determined. A.

612.85

8337. DOWNWARD SPREAD OF MASKING. W.Spieth.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 502-5 (April, 1957).

Pulsed pure-tone audiograms were obtained in quiet and in the presence of narrow bands of noise centred at 500, 1000, 2000, and 4000 c/s and at several levels. The masking produced at lower frequencies was of particular interest: The bands of noise at about 75 dB per cycle SPL produced from 12 to 24 dB of masking at 100 c/s and from 25 to 40 dB of masking at frequencies between about 200 c/s and the lower effective limit of the band of noise. This phenomenon contrasts with the fact (briefly reaffirmed in this paper) that a single pure tone of comparable frequency and intensity does not produce appreciable masking at these lower frequencies. It is hypothesized that a band of noise is functionally somewhat equivalent to a bunch of pure tones which when passed through a nonlinear transducer (the ear), produce aural difference tones which elevate the threshold for signals of lower frequency, while a single tone masker would not have this effect. It was found that two pure tones at a spectrum level and at frequencies comparable to the bands of noise do produce aural difference tones (as measured by best beats) of a level which correspond well with the level of lower frequency masking effects in question. A.

612.85

8338. REMOTE MASKING IN SELECTED FREQUENCY REGIONS. B.H.Deatherage, R.C.Bilger and D.H.Eldredge.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 512-14 (April, 1957).

Masked audiograms for six different masking stimuli were obtained from five observers. The audiograms show that remote masking can be controlled with respect to frequency region by controlling the envelope of the masking sound. Regular variations in the envelope at, say, 500 c/s produce remote masking in the 500 c/s region; while irregular, "random" variations produce equal amounts of masking everywhere outside the frequency region corresponding to the masking band or tone. It is argued that the constant masking seen in remote masking is related to the fact that signal frequencies are differentially attenuated in their transmission from the tympanum to the cochlear partition, while the masking frequencies are not since they are actually generated at the cochlear partition itself. A.

612.85

8339. SIMULTANEOUS TWO-TONE PITCH DISCRIMINATION. W.R.Thurlow and S.Bernstein.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 515-19 (April, 1957).

The frequency separation between two simultaneously sounding tones necessary to give perception of two pitches has been investigated. Frequency levels of 200, 1000, 4000, 6000, and 10 000 c/s were used. For the two-ear condition (where one tone was led to one

ear, the other tone to the other ear), no striking differences were found between results at sensation levels of 10, 30, and 50 dB. When both tones were led to the same ear, results tended to approach the two-ear situation when masking and interaction effects were minimized. The relation of the two-ear results to localization is discussed. Finally special phenomena are described which arise when two low frequencies, related by simple multiples, are used in the two-ear situation. A.

612.85

8340. FREQUENCY DIFFERENCE LIMENS FOR NARROW BANDS OF NOISE. R.M.Michaels.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 520-2 (April, 1957).

Frequency difference limens (DL) were measured for Gaussian noise having band widths of $\frac{1}{2}$ to 64 c/s centred at 800 c/s and for a pure tone, also at 800 c/s. Six listeners were used, and the DL's defined as the probable errors of the fitted transition curves. For band widths wider than 8 c/s, the DL rises regularly. Between $\frac{1}{2}$ to 8 c/s the threshold changes are small, having a minimum at about 8 c/s. None of the DL's for noise approach that of the pure tone, all being at least twice as large. It is suggested that the failure of ΔF for narrow bands of noise to converge on ΔF for a pure tone is due to the dependence of frequency discrimination on intensity discrimination. In narrow bands of noise, the auditory system follows the amplitude fluctuations, which increases the uncertainty of judgments of intensitive differences. For the bands of noise wider than 8 c/s, ΔF increases directly with band width. A linear increase in ΔF with band width is predicted for a limited range of band width and was found to fit the data. A.

612.858

8341. SENSATIONS ON THE SKIN SIMILAR TO DIRECTIONAL HEARING, BEATS, AND HARMONICS OF THE EAR. G.v.Békésy.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 489-501 (April, 1957).

A mechanical model of the cochlea in which the skin of the arm is used as a sense organ compared with the organ of Corti. Three phenomena were investigated: (1) directional hearing, (2) beats, and (3) harmonics. For directional hearing almost no differences were found between hearing and the sensation produced by the model. In the case of beats it was possible to confirm the earlier observations of Helmholtz by improving the frequency resolution of the model ear. Concerning the harmonics it was found that the method of best beats does not permit the measurement of overtones of the ear. A.

612.858.71

8342. AUDITORY THRESHOLD.
R.R.McPherson and T.G.Birdsall.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 393-4 (March, 1957).

Data obtained by Fairbanks et al. (Abstr. 6487/1956) are interpreted in terms of a statistical decision model. Subjects in a threshold test were divided into a positive and negative group, those who were to respond when they heard a tone in noise, and those who were to respond when they did not. The data are plotted on bivariate normal graph paper, and are seen to fit the normal distribution closely. The difference between the responses of the positive and negative observers is due to the different instructions given, and shows not a difference in ability to detect the tone, but in the acceptance criterion, i.e. a willingness on the part of the negative group to make more false alarms. D.J.Hall

TECHNIQUE. MATERIALS 62/69

621.61 : 534.39

8343. ACOUSTIC AIR PUMP. T.M.Dauphinee.
Rev. sci. Instrum., Vol. 28, No. 6, 452 (June, 1957).

An air circulating pump that works on the principle of acoustic wind is described. The pump will move up to 700 l./min of air when powered at 60 c/s by a 4 in. loudspeaker. The speaker diaphragm is the only moving part and could be protected by inert material when it is desired to seal in and circulate corrosive gases. A.C. pickup from the speaker is so small as to be negligible in most instances. A.

621.9 : 534.321.9

8344. EFFECT OF PRESSURE BETWEEN TOOL TIP AND WORKPIECE ON THE RATE OF ULTRASONIC MACHINING IN KETOS TOOL STEEL. D.Goetze.
J. Acoust. Soc. Amer., Vol. 29, No. 4, 426-31 (April, 1957).

Data are presented for the ultrasonic machining rate in Ketos tool steel obtained by using rectangular tool tips having different perimeters and circular tool tips having different radii. It is shown that the pressure rather than the force maintained between the tool tip and the workpiece is pertinent in the ultrasonic machining process, and that the ratio C/A of the tool tip perimeter C to the tool tip area A is of importance. It is also shown that for rectangular and circular tool tips a critical machining rate V_0 and a critical pressure P_0 exists, the values of which are related to the ratio C/A by the two simple expressions $V_0 = 2\xi\nu d\,M(C/A)$ and $P_0 = L(C/A)$, where 2ξ and ν are the peak to peak amplitude and the frequency of vibration respectively, d is the abrasive particle diameter, and M and L are parameters independent of 2ξ, ν, d, C or A. On the basis of the above two equations a phenomenological expression is derived which for circular and rectangular tool tips relates the machining rate in general to the pressure in general. A.

669.04

8345. CONTRIBUTION TO THE FLOATING ZONE REFINING OF SILICON. E.Buehler.
Rev. sci. Instrum., Vol. 28, No. 6, 453-60 (June, 1957).

A floating zone refining apparatus for silicon, which can operate unattended, has been assembled to assist in the production of high purity material for research purposes. Features of this equipment are a simple mechanical drive, a switching panel to recycle the apparatus, and a self stabilizing r.f. heating circuit to maintain constant zone length. Silicon containing less than 1 part per 10^9 of electrically active impurities (resistivity of 16 000 ohm cm and lifetime of 1.2 milliseconds) has been prepared. The effect of many-pass refinings on the diameter of the sample is discussed. Surface tension effects on material transport are significant. A.

PHOTOGRAPHY 77

771.531 : 535.317.1

THE LIGHT DISTRIBUTION IN THE PHOTOGRAPHIC IMAGE.
See Abstr. 7710-11

771.534

8346. THE INFLUENCE OF A SUBSEQUENT ILLUMINATION WITH INFRARED RAYS ON THE INCREASE OF RESOLVING POWER OF THE LIGHT-SENSITIVE EMULSION.
V.Blumová and J.Hrdlička.
Czech. J. Phys., Vol. 6, No. 5, 529-31 (Oct., 1956). In German.

Preliminary experiments are described which may prove to give more reliable values of emulsion resolving power. By infrared treatment of the latent image, the curve of resolving power (in μ) v. log exposure time is altered in shape and position, in particular the minimum distance resolvable is depressed to still lower values. S.T.Henderson

778.34

8347. ON THE RELATION BETWEEN BLOB-DENSITY AND VELOCITY OF A SINGLY CHARGED PARTICLE IN G-5 EMULSION. G.Alexander and R.H.W.Johnston.
Nuovo Cimento (Ser. 10), Vol. 5, No. 2, 363-79 (Feb., 1957).

A calibrated curve is presented expressing grain density as a function of $p\beta c$ for π- and μ-mesons, and is found to be in good agreement with the Bethe—Bloch formula for "restricted ionization loss". The 2-body decays of K-particles were used as monochromatic sources of π- and μ-mesons. Blob-density measurements were reduced to grain-density by means of the O'Ceallaigh theory. A "least squares fit" of the experimental points to the Bethe—Bloch formula, together with the experimental "plateau" point, yielded for the mean ionization potential in AgBr the value (530 ± 100) eV, and for the maximum energy transfer the value (2.9 ± 0.5) x 10^4 eV. A.

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957). Reprints of this List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C. 2, price 2s. 0d. post free.
The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

NEW JOURNALS

Nukleonika
Nukleonika — Polska Akademia Nauk, Pałac Kultury i Nauki, Warsaw.
Vol. 1, No. 1 dated 1956.

Ukraïn. fiz. Zh.
Ukraïns'kiĭ Fizichniĭ Zhurnal — Akademiya Nauk Ukraïnskoi S.S.R., Vladimirskaya 58a, Kiev.

CHANGE OF ADDRESS

Bull. Un. Exploit. Elect. Belgique
Bulletin Bimestriel de l'Union des Exploitations Electriques en Belgique — address changed to: 7 Cantersteen, Galerie Ravenstein 4, Brussels, as from June, 1957.

ERRATA

Abstr. 1050 (1953) line 2	:	for "686" read "680"
Abstr. 1097 (1953) line 2	:	for "679" read "682"
Abstr. 1121 (1953) line 3	:	for "682" read "684"
Abstr. 1135 (1953) line 2	:	for "677" read "686"
Abstr. 805 (1957) line 2	:	for "resin without grease" read "rubber without lubricant"
line 5	:	for "resin" read "rubber"
Abstr. 807 (1957) lines 2 and 4	:	for "resin" read "rubber"
Abstr. 994 (1957) line 4	:	for "Vol. 40" read "Vol. 46"

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